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A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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A New Lathe Chuck for Turning Eccentrics.

The accompanying illustrations show a new lathe chuck recently brought out by James R. Howgate, of Schenectady, N. Y. Its construction is such as to assume various degrees of eccentricity to facilitate the turning of eccentrics for engines, pumps, and the like. The face-plate *I* is of the regular form, and is screwed on to the lathe spindle in the usual way. To this face-plate a frame *J* is bolted, its outer face being slotted to receive the shank of the taper-pin *A*. A screw *G* extends through one end of the frame and through the shank of the taper-pin. By means of this screw the taper-pin is adjusted in either direction relative to the axis of the lathe spindle, so as take in eccentrics of different throws; the exact throw is determined by the scale *K*.

A split bushing surrounds the taper-pin, and is made to expand by means of the nut *C* and washer *D* in the bore of the eccentric which is shown in dotted lines. The set-screws in the lug *E*, whose shank also slides in the slot of the frame *J*, hold the arm of the eccentric, thereby securing a firm hold of the eccentric at one point while the bushing *B* holds it very firmly at another point. The washer *D* is provided with a series of holes to receive the dead center of the lathe when it is considered necessary to do so. By these means the chuck is firmly supported, and the work is kept from chattering.

This chuck has been used for some time in the Schenectady Locomotive Works, and is said to have given excellent satisfaction.

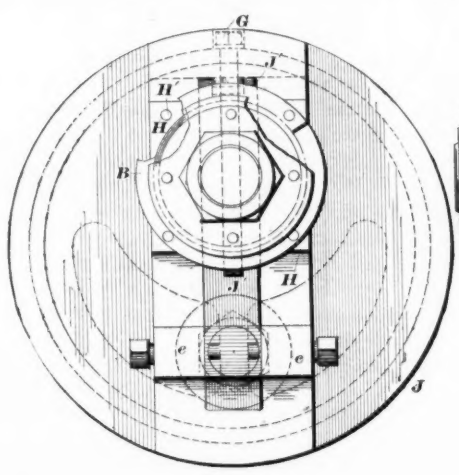


Fig. 1

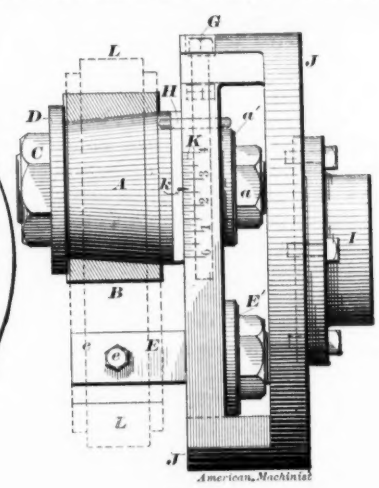


Fig. 2

CHUCK FOR TURNING ECCENTRICS.

Drawing Board for Laying Out Metal Work.

BY GEORGE GUNTZ.

In my present occupation it is necessary to lay out my work, or at least large sections of it, full size, and as I have a great many intricate patterns in sheet metal work to develop, it can easily be seen that to do this on the ordinary 30″x50″ office drawing board would be impossible, a much larger board is necessary. After studying over the matter and considering the space required for a large board, convenience of getting around to all sides of it and handling a T-square at least 10 feet long, also many other items of convenience that will be apparent as we proceed I concluded that a vertical board would suit my purpose best. On looking over the market I found vertical drawing boards, but to my eye there were several objections to them. First, there were none large enough; then it would cost too much to have one made to order by the regular makers. Then, again, the mechanism for handling the straight-edge of such a length was rather weak, so I started in to do the next best thing, that is, devise one myself and have it made, which I did, and now having used it for about six months, it has answered my purpose so well that I thought perhaps others might find it convenient.

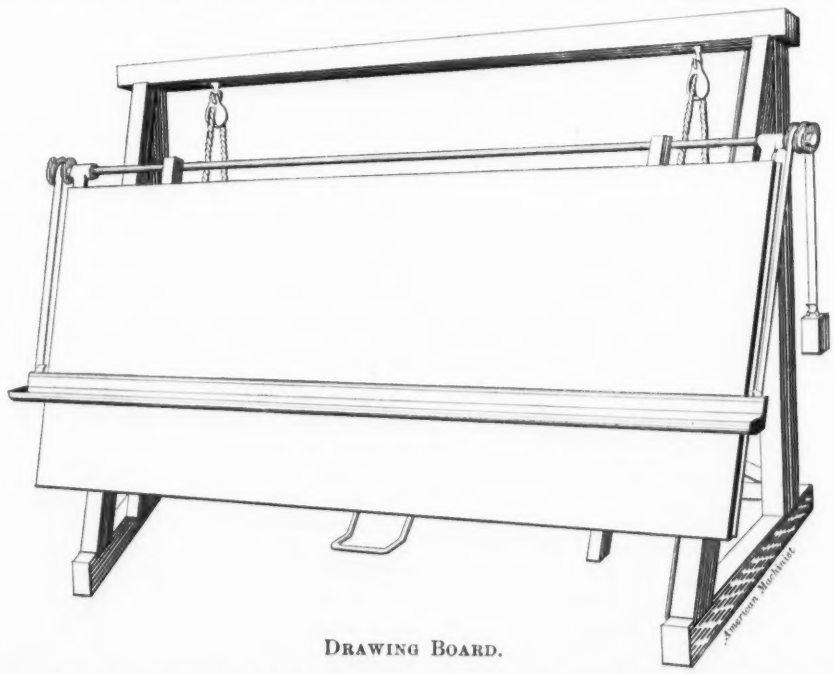
I had a carpenter make the board 5 feet by 10 feet by 1⅛ inches thick, jointed and glued, with two 2″ by 6″ battens, with slotted holes for screws screwed on the back. The back of the board is grooved with grooves 6″ apart. The two trestles are of 3″x3″ spruce as is also the top rail. The rear posts stand vertically and the front ones at an angle of about 3 feet in 9 feet. The total height of frame is 10 feet, the length is 8 feet 6 inches and the length of foot is 3 feet 6 inches. The straight-edge is of cherry ⅝″x 5″ with the working edge chamfered down to ⅛″. The projecting pieces, two each at top and bottom, are of pine. Their ends are halved so as to have their faces come flush with the faces of the board. They are screwed to the back of the board. I got a piece of $\frac{1}{16}\frac{3}{8}''$ shafting 10 feet 6 inches long, two journal boxes and two set-screw collars, also four hammock hooks, two small iron blocks large enough to take ½″ rope, four sash pulleys, such as are made for flat sash cord, two pieces of ¼″x1½″ flat iron and two pieces of ½″ manilla rope about 7 feet long each. In one end of each piece of rope I spliced an eye, and the other end I moused, that is, tied a string around it, sailor fashion, to keep it from unraveling. I then made two cans of light sheet-iron 9″ in diameter and 28″ high with bails to them. Also after weighing the straight-edge I made two weights of solder. I made of sheet copper a trough the length of the straight-edge, two angles of the same material ½″x½″ with an edge on one leg doubled down so as to have two thicknesses of stock. I also made two double pulleys with flanges for the hubs of which I used the collars before mentioned. The pulleys are made of No. 18 gauge galvanized iron. They have flanges which are 5″ in diameter. The pulleys are 4″ in diameter.

You can see what I did with the shafting, two of the hammock hooks, the two blocks, and the rope. The other two hammock hooks I screwed fast to the back of the board about one-quarter of the width of the board from the top. To these I hooked the eyes of the ropes, and to the other end of the ropes I tied the cans, which I filled with sand till they balanced the board. After drilling screw holes through the two pieces of ¼″x1½″ flat iron, I screwed them to the sides of the inclined legs of the trestles, letting them project about ⅝″ past the face to form a track, and on the back of the board, near the top and bottom, I screwed two of the sash pulleys on each side to run on the tracks. To each end of the board I fastened one of the copper angles with the double edge out, and to the back of the straight-edge secured a clip or guide to fit over the projecting legs of the angles to hold the straight-edge to the board. Also another clip with two slots in it about $\frac{1}{16}''$ wide by ⅜″ long and ½″ apart, and on the front of the straight-edge near the bottom I fastened the copper trough. Then I cut from an old metallic tape line four pieces of sufficient length to take one turn around the flanged pulleys, and reach to the bottom of the board. I fastened one end of two of these pieces to a pulley by cutting a slot in the rim of the pulley, and pushing the bight of the tape through the slot, and putting a wire in the loop. The other ends were fastened, one to the straight-edge by tucking it through the slots in the clip before mentioned, and the other was fastened to the counter-weight made of solder. The other two pieces of tape I fastened in the same manner at the other end of the board.

To the bottom of the board I fixed a stirrup as shown. To move the board down I put my foot on the stirrup and push; to raise it I take hold of the bottom and lift, and only have to exert force enough to overcome the friction of the working parts. The same with the straight-edge, and since the pulleys are fast to the shaft, if one is revolved the other will have to revolve, so you can see that it doesn't make any difference where you take hold of the straight-edge to move it up and down, it is bound to move parallel. In the trough I keep all my pencils, tools, thumb-tacks and rubber. The object of the projecting pieces at the top and bottom is to keep the straight-edge from falling back when it is necessary to move it up above or down below the board in order to leave the whole surface clear when pulling on paper the entire width of the board.

If you have any use for a board like this, try it.

It works like a charm.



DRAWING BOARD.

The Tool-dresser.

BY B. F. SPALDING.

I wish to say some things about blacksmithing—trite to old shopmen, but probably of interest to younger ones—not to college students, but to the smutty genius who is glad of fifty cents a day, and the chance to learn an honorable trade.

The position of the person whose business it is to do the forging and tempering of tools for a machine shop, is one of considerable responsibility. The business is a specialty in blacksmithing and requires peculiar training. Every shop has its tool-dresser, and he has a good chance to learn human nature as developed in the shop.

Where do all the tool-dressers come from? Some of them are country blacksmiths who have drifted into the towns and got into the shop; some have learned machine blacksmithing and have finally settled down into this specialty, and some have never learned anything else except to work on tools; they learned as boys to fix drills first, and ambitiously acquired the art of fixing and making other tools, and after a while became recognized tool-dressers. They stopped at this stage and never went on to learn the further practice of blacksmithing, or they went on and came back to this part, liking it the best. But every tool-dresser sees days when he is entirely out of sorts with

his business and wishes he was almost anything else.

If a blacksmith is not spoiled by working on iron until he gains a habit of heating his metal hotter than steel ought to be heated, a general experience on different kinds of work is of great utility to the tool-dresser. Some of the very best in the country have been originally carriage smiths. A great deal of the composition of a good steel workman must pre-exist in the man himself; he must possess the fundamental qualities; experience can only give the skill. That is the reason why the excellence of a workman cannot be determined by his training; there are excellent tool-dressers who have come into the trade in all the ways I have mentioned.

Let it not be doubted that every blacksmith knows how to work steel; he can heat it, and pound it, and harden it, and draw the color, and what else is there to do? These things comprehend all there is in the practice of steel working as far as fire and water are connected with the blacksmith. If he heats it right, pounds it with judgment, hardens it with care, and draws the temper to critical inspection tests, he has done all that any one can do to insure the best results. You might stand where you could observe all his movements and not notice but that he did all these things perfectly, and yet the result might not prove satisfactory. When you saw the piece was warped you might remember and say that "he hammered on one side a little more than on the other" or that "he didn't dip it into the water quite straight." You may feel assured that the tool-dresser is quite accustomed to hearing remarks of this kind.

It must not be expected that a man who is in a responsible position can always feel the responsibility of his position. Constant danger diminishes caution. But he should adopt the habit of always acting as though he felt it; he should be always careful. Sometimes, however, the very best will be surprised out of adopted habits, and sometimes a matter is of more importance than appears on its face. If a man is going to use a tool, right in the shop, it will not be of such vital importance that it shall be well made as it would be if he was going to a distance to use it, for in the latter case it would be more difficult to have it repaired.

I saw a die-sinker once who had a handful of nice chisels to harden; he had redressed them himself at the portable forge in the tool-room, refining them by blows growing gradually lighter as the heat departed; then he let them cool off, rough ground them, and had taken them to the forge again when the tool-dresser came upon the scene. "Say," said the die-sinker, "I wish you would harden these for me." "Of course I will," responded the obliging smith, and putting them into the fire he performed the operation with professional expedition. "There they are," he said in a few moments, as he laid the last one on the forge and turned away.

After he had gone the die-sinker looked them over critically, and then said in an apologetic manner, "That die steel is so hard that I guess I'll have to make some of these a little harder." Then he went to work upon one, heated it very lightly, and hammered it over and cut off the point, and he did the same thing with each of them; then he reground them, and then slowly heating an inch or so of the points a little more than hot enough to flash gunpowder, he quenched them in water as far up as the glow extended. He did not allow much of the heat for drawing the temper to "run down," but drew them by holding them over the fire. He left the color for about half an inch back of the red which just comes before the first blue. It took him a great deal longer to temper them than it did the tool-dresser, but I thought that if the tool-dresser had felt that his connection with those bits of steel was to continue until they were worn out, broken, or in any way needed repairs, he would, like the die-sinker, have spent a larger proportion of it in their preparation, so as to have more satisfaction in working with them in the rest of it. When the tool-dresser has tempered a tool his work on it is done. As far as he is concerned the tool is finished. To him it is a thing to be worked upon, but to the man who is to use it, it is a thing to be worked with. As it is natural for men to slide their work out of their hands with all attainable facility and dispatch it requires a sternly set purpose to always bestow a proper degree of care upon the work of tempering. The temperer must have a very good understanding and be sensitively conscious of the time, patience and painstaking skill, which are required to make a fine cutting tool, such, for example, as a model standard tap, in order to be alive to the responsibility he incurs when he takes it in hand to give it its prime value, which is its ability to cut its shape into the objects it has to form. He needs to identify himself, not only with the work which has been done upon the tool before it comes to him, but also with the work which it is to do after it leaves him. He doesn't want it to break in the first steel hole it enters, and have its splintered fragments damn him with their glitter, and he dreads to hear it shriek out of every long brass nut it may be forced into: "Tom Jones hardened me! Tom Jones tempered me!! Tom Jones murdered me!!!" He must get it neither too hard nor too soft.

The apprentice whose foreman gives him the opportunity to learn tool-dressing should appreciate the favor. Even though he may not pursue it as a business he will always find it to be of great advantage to have an acquaintance with machinists' tools, and an insight into the work they are designed to perform. When a young man is thus singled out for a responsible position it implies that he has manifested some degree of fitness for it, which the foreman has noticed, and to have his qualities so recognized is something which may properly gratify a young man who desires to rise in his vocation and to be well paid for the time he spends in its practice.

As the position of the tool-dresser is of considerable responsibility, as his skill affects the figures which represent profit and loss as much, perhaps more, than that of any other workman in the establishment, the wages he receives are usually in accordance, and such as will compensate the more intelligent class of mechanics, not too much, that wouldn't do; we only keep horses in good condition, it is another kind of animal that we fatten. The pay is not given altogether for what the man does, but partly for what he knows. He may not work any harder than the man who is straightening iron next to him, but he must be paid more, even when he is straightening iron, for he knows not only how to do that kind of work, but also other things which have to be done, and which require a higher class of skill. If these other things were not to be done, if there was nothing to do but to straighten iron, his knowledge of steel working would cut no figure, and he would only be paid in proportion to his skill as a straightener of iron.

Something may be said in regard to the manual dexterity which is required to dress tools; good, smooth forging is of prime importance. It is an old Scotch saying about this matter and worthy of all acceptance that, "Filing gaes weel where filing should be, but gin it ought to be smidded, it's abominable." The workman's deftness of hand receives too little attention in the efforts which are exerted to make brainy mechanics. An anecdote about Ruskin conveys the ideas of a good thinker about this matter. He hired a Scotch mason to do some little job in his garden, and many wrangles they had over the best methods of doing various things, Ruskin contending that the author of "Stones of Venice" should be allowed to know how the little building they were working on ought to be made, and the mason stubbornly holding out, and having his own way. One day the mason wanted some money, and after giving it to him, Ruskin handed him a receipt to sign. The man was confused, hesitated, and at last confessed that he could not write. This delighted Ruskin, who at once cried out, "Ah! now I know why you are such a thoroughly good mechanic." If the great art-critic had been consistent, he would never have undertaken to dictate to an ignorant machanic the way in which he should do his work. I remember that when I was a young man, and went to George Yale, foreman blacksmith at Sharp's Rifle factory, Hartford, for a job, George asked a friend of mine if I knew anything about blacksmithing. I did not feel at all flattered by my friend's reply, he said, "He don't know anything else!" Probably Yale's views agreed with Ruskin's for I got the job.

The mere manual skill which is required to give shape to lathe tools, planer tools, drills or chisels is something which can be acquired in a very short time by any one who, like a carpenter, cordwainer, or blacksmith, has become by practice so used to handling a hammer that he can set his blows just where he intends to. The amount of practice which is required by some people to learn to strike true, and make a smooth surface, is much greater than with others. Some will never learn to strike true, while others do it naturally; the same as one boy will throw stones at a mark with a much better aim than others. One man screws his rifle in a vise to take aim, and another shoots as straight off-hand. That is science against skill, and skill gets there first. If the tool-dresser has not the skill to handle his hammer, he can use the set-hammer and the flatter; that may be science; but when he and his helper strike direct on the hot metal, and it comes to shape smoothly beneath their blows, that is skill, and the steel is the better for the exercise of it. This is the first thing the tool-dresser should acquire.

When I first went into the blacksmith shop to serve my time the boss held a bar of $4'' \times \frac{3}{4}''$ cold blister steel on an anvil for me to strike on, with a long handled 10-pound sledge, first "uphand" a few blows on the flat side, until my uneasiness, tremor, and the sense that all the hands in the shop were looking at me (stage-fright) had been overcome so that I could hit the steel somewhere near the center; then he turned it up on the edge, and I—I was staggered, I didn't think I could hit that—it was too thin! I hesitated a moment, and then let her go, and scored a hit. He practiced me for a spell in this way, turning the bar so that I struck sometimes on the flat, sometimes on the edge—and occasionally on the anvil—until I was tired, but had gained some confidence. Some time afterwards he put me through the same exercise, but had me "swing over" instead of striking "uphand." He repeated these lessons until I could strike where I was directed to. He did not let me strike for the other blacksmiths until he had trained me himself.

After I had got to be a blacksmith myself, I always had objections to having green helpers strike for me, because, for persons of honorable intentions, they are certainly very dangerous. They are liable not only to dig holes with their sledges into hot iron, which can be prevented by interposing a flatter, but they knock pieces out of the flatter and other tools, as well as out of the anvil, which fly promiscuously about with the velocity of rifle balls. The fact is recognized among blacksmiths that skillful helpers are just as much entitled to be considered good workmen as the men that stand on the other side of the anvil.

Apprentices should not feel that they are not in a position to learn while they are kept at helping. They should not have suspicions that they are being held back, but they should exert themselves to excel in striking, for that is the pith of the trade. When I see a blacksmith who handles a sledge awkwardly, I look upon him as a sailor looks at a captain who has "crawled in at the cabin window," and think that he had better go back and learn the A B C of his trade.

The apprentice should take pride in having the heads of the tools he strikes on batter down evenly, and not get lopsided, because his blows have not been level. If he is not tall enough to reach well up on top of the tools, let him get a platform to stand on, if the blacksmith will not tip his anvil forward enough to answer the same purpose. If an apprentice can strike true with a hand hammer, he can be taught in half an hour of personal instruction to make almost any of the common tools used in the machine shop; a carpenter who has never seen the inside of a blacksmith shop can be taught as quickly, but this is not the best way to learn the blacksmith's art, any more than the best way to learn to sing is to commence by warbling a song. If you propose to teach an apt boy to interpret the works of the great masters on the violin, you must not fiddle the tune in his hearing, or he will play it off-hand "by ear"; and written music will always look to him like a mob of contrabands scrabbling over a five-rail fence. It is not the jigs he fiddles, but the exercises he practices, that will make him a Paganini. With the singer it is probably not the particular song, but the best method of vocalizing which she must acquire. That, I suppose; this, I know: That with the tool-dresser it is not the learning to shape steel in one, or two, or half a dozen certain forms which will make him a good workman, but it is the skill which is gained by general practice, and the knowledge which is acquired by wide and varied experience.

It is undoubtedly a great help to a good apprentice to be taught how to make some shapes of tools from time to time; it stimulates, encourages, and gives him a zest for the business, which leads him to watch more closely the blacksmith he helps, for the purpose of learning what steps he takes in forging different articles, how he goes about them, and why he takes them in just such a sequence. As his term of helping is lengthened out, and he is only occasionally given a chance to work at the fire, he is having a chance to help more different workmen, and if he is encouraged to try and learn their ways, he will become acquainted with a greater variety of methods of doing work, and increase the stock of resources he is laying up for his future use. This is better for him than to learn to do a certain thing, and give him a fire at once, and let him work at it, even if it is such a thing as he can work on "by the piece," and make treble his ordinary wages. He should not waste the valuable time of his youth in making a little money, for he can use it to acquire knowledge and skill, and thus lay broad and deep the foundations of future success. Money and property one may sometimes lose, but habituated manual dexterity, never. The muscles once trained to move in a certain manner without special volition, retain through life the impression they have received; he who could skate when he was a boy, can skate when he is a man.

Besides his fondness for rare books and fine old prints, Clarence S. Bement, of the firm of Bement, Miles & Co., has a deep love for the science of mineralogy. His collection of minerals is second to but one in all the world—that of the British Museum; and there are a number of specimens among his treasures which even that anciently founded and extremely wealthy institution does not possess. One who understands pretty well the value of such a collection has declared that Mr. Bement's museum is worth fully half a million dollars. Mr. Bement's expenditures for rare specimens and fine collections have aggregated up in the hundreds of thousands of dollars. One grand room, resembling a spacious museum hall, has been fitted up in his residence with innumerable high cabinets crowded with specimens. Three of the drawers alone would make any man—even one who is not a mineral collector—happy, for they contain big nuggets of gold. There are other drawers full of uncut stones, treasures in themselves.—*Philadelphia Record.*

It is said that a thimble will hold over 100,000 of the smallest screws made.

"The Engineer" and the Buckeye Engine at Chicago.

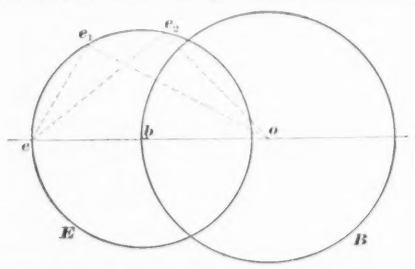
In our issue of October 12th we referred to the blunderings of the "Special Commissioner" of *The Engineer* (London) in his rather evident effort to discredit the Buckeye engine at Chicago. In a recent issue, *The Engineer* publishes the following letter from the Buckeye Company, with the appended explanation:

THE BUCKEYE ENGINE.

SIR:—Our attention has been recently called to the article in your issue of September 22d, explaining and illustrating our 1,250 horse-power triple expansion engine at the World's Exposition at Chicago. While we are pleased at the amount of space you have seen fit to give the matter, we regret very much that the writer of it did not take the trouble to familiarize himself with the facts before attempting to instruct others in the details of our methods of construction.

Among other features of our exhibit was a small engine made "sectional" by cutting through the cylinder and valves horizontally, showing the internal construction of the valves, piston, etc. This was driven by means of a small electric motor at a very slow speed—about eight revolutions per minute—to show the actual operation of the valves relative to each other and to the piston. The governor was made easily adjustable by hand to change the point of cut-off to any desired extent. This proved to be an extremely interesting and instructive exhibit to all persons interested in steam engineering, and was continually surrounded by an appreciative crowd of visitors, most of whom could doubtless learn more in a few minutes from this object lesson than they could ever derive from a geometric demonstration. We are very sorry that your correspondent did not become one of this gathering of students for a few moments, he would thereby most certainly have saved you from the error of publishing the following statement: "The Buckeye Engine Company affirms that because the pin *B* has its bearing in the rocker arm *A*, and has therefore a motion identical with that of the main valve, except that it is upon a smaller scale, and because the gov ernor eccentric has a constant throw, there fore the cut off valve has a constant travel over its seat on the main valve, *i. e.*, relatively to the main valve. This is a curious misconception."

The attempt at a demonstration following this is so grievously bad, that we drop it with the remark that the author has become confused between the motion of the cut off valve relative to its seat on the main valve, and the motion of the same relative to the cylinder or any stationary point, and yet has not correctly described the latter relation. The fact is that the movements produced by means of the compound rocker arm are the same as would be produced directly by two eccentrics, one—the governor eccentric—



adjustable about the other—the main eccentric. Referring to the figure, let the circle *B* be the circular path of the center of the main eccentric, and for the moment consider its center to be at *b*. Let *e b* be the eccentricity of the cut off eccentric, and *E* the circle described by the center of this eccentric if it were adjustable about the center of the main eccentric instead of about the center of the shaft. Then the point *e* being moved to other positions, as e^1, e^2, the lines e^1 *o*, e^2 *o*, etc., are the half distances moved through by the cut-off valve relative to any stationary point, but the radius *e b* is the half distance moved through by the cut-off valve relative to the main valve at all times. The fact that this arrangement of eccentrics connected direct to the valve is the equivalent of the arrangement in our engines when connected through the compound rocker arm, we merely state without demonstration. It will require no demonstration to those familiar with geometry, nor to others familiar only with our engine. We have built these engines for some twenty years past, and the geometry of their valve movement has been taught in all the technical schools of this country, and written about by professors in their text-books for a number of years. There is plenty of opportunity for your correspondent to inform himself.

Your article also says that "the company states that the engine uses from 23½ lbs. to 35 lbs. of water per indicated horse-power per hour. We congratulate them in that the water consumption sometimes goes half a pound below twenty four." This statement nas been referred to, in what seems to us appropriate language, in an editorial of the AMERICAN MACHINIST, of New York. We wish to add that your writer evidently refers to a paragraph in our catalogue No. 1 on simple engines, in which we make a statement as to the actual water rate of our simple non-condensing engines, from the largest to the smallest sizes.

Without a shadow of reason he has applied this statement to our 1,250 horse power triple-expansion condensing engine. He should have borne in mind that compounding, multi-compounding, and condensing are made use of by builders of engines to improve economy in use of steam. If he had interviewed our representatives in Chicago in regard to the matter, they would have told him, as we do now, that we claim for the engine as good economy as can be obtained by any other unjacketed, triple expansion engine, of equal power and equal initial pressure, of whatever type, and built in whatever country.

Various other statements appear in the writing, made in a spirit of captious criticism, and based on a misunderstanding of facts, which we will not reply to further. We hope you will see fit to accord us the courtesy of giving our remarks as great publicity as you have those containing the errors which we have pointed out.

BUCKEYE ENGINE CO.
(Per A. K. M.)

[On receipt of the above letter we handed it to our Special Commissioner. He has referred to the article in question, which he had not previously seen in print. There are, he says, misprints in the descriptions of the valve diagram, and in the diagram itself, due to the impossibility of submitting proofs to him before publication. "Some point" is printed for "same point," and in the diagram l_3 l_1 l_2 appears instead of e_1 e_3 e_2. This, of course, affects the intelligibility of the paragraph; but, beyond this, our Commissioner has to acknowledge that he fell into error, and that the Buckeye Engine Company's statement as regards the constancy of the travel of the cut-off valve over its seat on the main valve is correct. The point is not an important one, and was not indicated in the article objected to as one of any importance. The writer, however, much regrets that he should have made this slip, which would assuredly have been recognized and corrected if he had had opportunity to read proofs before publication. His object and desire at Chicago was to give the fullest credit for all points of novelty and excellence which he discovered in the American engines exhibited, and he believes that he has done so to the best of his ability. As regards the consumption of water, the information given was supplied by the engine makers' own representative.—ED. E]

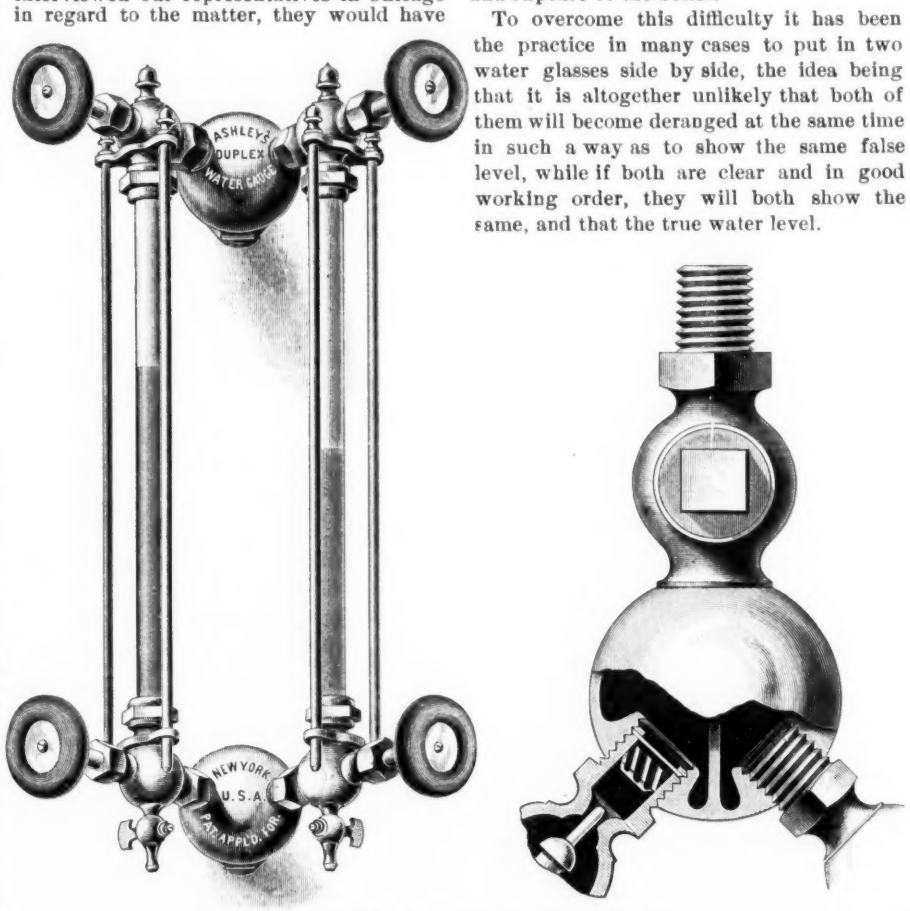
The interdependence of various industries is rather clearly set forth in the statement that at one time during the recent coal strike in Britain nine tenths of the working people in Sheffield were out of employment.

The Ashley Duplex Water Gauge.

We illustrate herewith an improvement in water gauges, which is designed to add materially to their reliability without much increasing their expense, nor the number of holes to be tapped into the boiler.

It is well known that one of the principal difficulties in the use of the ordinary gauge glass arises from the fact that impurities contained in the water gradually deposit, and obstruct the passages to the glass, usually at the bottom, and cause the glass to indicate a false water line, usually too high, which, of course, causes danger of burning and rupture of the boiler.

To overcome this difficulty it has been the practice in many cases to put in two water glasses side by side, the idea being that it is altogether unlikely that both of them will become deranged at the same time in such a way as to show the same false level, while if both are clear and in good working order, they will both show the same, and that the true water level.



THE ASHLEY DUPLEX WATER GAUGE.

The main objection to this arrangement is in the extra openings to the boiler, a difficulty which is overcome by the duplex glass shown. In this there are two glasses, mounted, as shown, in a single pair of fittings, there being in these fittings a partition, as shown in the partial sectional view, which partition runs all the way through the head to the extreme end of the threaded portion within the boiler, and thus makes two complete and separate passages in each head—one for each glass, and gives each its own separate communication with the boiler, the same as though tapped in at different points, the passages being at all points larger than the valve openings, which are apt to stop up first.

Arranged in this way the glasses are sure to be placed at the same level in the boiler, and are close enough for ready comparison of the water levels, and if at any time a difference in the two lines should appear, as is the case in the engraving, it then becomes certain that something is wrong with one or the other—presumably with the one showing the highest level, and they should be blown out until by repeated trials they indicate the same level.

The fittings are made in two sizes (½" and ¾") by Frank M. Ashley, 136 Liberty street, New York City.

Diploma Machinery.

Only a few days ago we asked which of the great Rand Gold Mining Companies was destined to be the possessor of the Ingersoll-Sergeant rock drill plant which was awarded the highest honors at the Chicago Exhibition. The plant was not fated to go a-begging, for the Crown Reef Company have ordered it to be delivered to them within the shortest possible time, and Messrs. Manion & Harlow have been exchanging cablegrams about it with their principals during the last day or two, with the result that the whole machinery will be on board a special steamer on Monday next. It speaks volumes of the position of these gold-fields that what is probably the finest rock-drill plant ever exhibited should be sent upon its way here within a few days after the jury had passed their verdict upon it. The people in the States have heard a good many tall stories, no doubt, about the greatness of the Witwatersrand, but the fact that we are ordering their best gold medal exhibition machinery is an object lesson that should make a strong impression on the "Amuricans." The plant is a cross compound one, having a high pressure steam cylinder of 18-inch bore, a low pressure one of 34-inch bore, and a 42-inch stroke. There are two latest improved Ingersoll Sergeant piston inlet air cylinders, both with an 18¼-inch bore and 42-inch stroke. The engine will be supplied with a surface condenser, with air and circulating pumps of the best type. The foundations will be proceeded with immediately, for Mr. Webber, the manager at the Crown Reef, does not mean to have a moment's delay in the erecting of the plant when it arrives. It will be put up by Mr. Blanton, an engineer from the States, and he is going to do all he can to have it running by the 1st of February, bar accidents. With this 25 drill plant the Crown Reef people should walk through the lower levels at a smart pace, for gold medal machinery should do gold medal work. The Rietfontein drill plant, by the way, is going well, Mr. Brisben says. He is quite satisfied that it may be left alone, and has come into town preparatory to going out to superintend operations at the Van Ryn and Ginsberg.—*The Star* (Johannesburg, South African Republic).

The Standard System.

BY B. E. D. STAFFORD.

The standard system of measurements, as adopted years ago, whereby the decimal figures are made a basis and the $\frac{1}{64}$ of an inch which seemed so small to the average machinist reduced to a thousandth part of an inch, is to day fully appreciated by those who are wise enough to adopt it, inasmuch as it insures the interchangeability of parts with exactness, and by the use of gauges, fixtures, jigs, test pieces, etc., in the construction of such, forms the most economic system to day if thoroughly adhered to of manufacturing machinery.

The cut and try system (as I call it) of manufacturing is far from being extinct, however. One has but to journey through the numerous shops and he will be surprised at the large number that still run on this basis. While it reflects no discredit as to the quality of their production, it is a poor incentive to the welfare of the future machinist, as also to the advancement of a universal system of construction.

The last ten years mark an era in the history of mechanical products that is remarkable, when we consider that in that period some of the most notable productions and radical changes have been made and universally adopted.

The electrical transmitting, lighting and motive system has been introduced throughout the world to such an extent that it is stupendous when we consider the short time in which these developments have been made and brought to a standard of practical efficiency and economic manufacture.

Type-writing, type setting and cash-registering machines, although conceived years ago, were never properly recognized until within a few years when the demand was so great that it seemed as though the production could not keep pace with it. These machines to day are the embodiment of simplicity, skill and accuracy, both in design and workmanship, which shows a marked advance in the system of manufacturing. Some of these inventions were conceived and experimentally exhibited years before, but their merits as to practical value and universal adoption were of late decision. Their conception alone created in other

channels like improvements and radical changes in the commercial interests of the country.

To further the advance of these marked improvements and get them into practical operation in the market, the machine tool shops have been taxed to their utmost capacity, not only furnishing machinery and tools but skilled mechanics acquainted with the manufacture of such, and the fact of manufacturing them low enough to insure universal use, at the same time maintaining exactness and superior quality, resulted in the adoption of the standard system throughout.

There are various other machines, too numerous to mention, built upon the same system, where parts measure and are regularly duplicated into ten-thousandths. In the manufacture of spinning spindles and parts for cotton machinery, I have found the limit to not exceed .001 of an inch in a production of 2,000 a day. Fine as it is for this class of machinery, it has proved more economical in adopting it as such than to manufacture on old methods. But a system of this nature cannot be rightly developed without the co-operation of the machinist. Methods of doing work necessarily change in the advent of improved tools. A spring caliper cuts no figure with a micrometer in measuring to a nicety any more than a two-foot rule does with a fine scale. It is a matter of guess-work over a certainty of exactness that has to be erased throughout the shop before the system can be rightly established.

The perfection of the small micrometers, together with the exactness of other small tools manufactured, has been instrumental in establishing the system in the hands of the workman in general. Standard plugs, gauges, and fine verniers, etc., are necessary adjuncts to a tool-room, but too expensive for the craft in general to own. But as the cost of the micrometer has been within reach of all, its use has always proved a good investment to those willing to co-operate.

In my experience I have hired tool-makers, or men who claimed they were such, and when presented with a drawing in decimals, not only were at a loss for tools to measure, but were entirely ignorant as to its meaning. One would naturally think a person that had worked fifteen years at the trade, and had built everything from a gun-boat to a watch pivot, would somewhere in his journey strike a shop where the system was used. It was but a short time ago I found the individual, and on reflection came to the conclusion that this world *was* large after all, though some of us think differently in the line of progress.

Manufacturing concerns outside of the machine tool industry would naturally look to such for indications of its use, both in the tools manufactured and skill employed, and while a good many of the tool shops recognize the system, there are a greater number that still cut and try; but for the future welfare of this particular branch, and as a requisite for skilled and advanced machinists, I hope it will be more universally adopted.

Worcester, Mass.

As of possible interest to "R. & S.," who ask in our issue of December 7th for information as to machinery for weaving wire, Edmund Morris, whose address is care of Vreeland Hotel, Michigan City, Ind., writes us that he has had experience in building and running such machinery and is acquainted with the present state of the art. Benjamin Scarles, 181 Sterling street, Clinton, Mass., also writes us that he has begun the manufacture of such machinery for the market.

Mr. George Richards, mechanical and consulting engineer, well known to many Americans, and who for twenty years has been engaged in business in England, proposes to add to his business that of arranging for the introduction of American patents, inventions and patented articles in England. Mr. Richards' extensive acquaintance with English manufacturers and purchasers, and with English business methods cannot fail to be of great advantage in this field. His address is Suffolk House, Laurence Pounterey Hill, London.

Referring to inquiries in our Question and Answer column not long since, George De Laval, care of the Knowles Pump Works, Warren, Mass., a relative of the inventor, volunteers to give any information required in regard to the De Laval steam turbine.

Machine Shop Milling Practice—II.

By HORACE L. ARNOLD.

The cutter mark, a mark made in almost all milled work by each complete turn of the cutters, forms a very curious subject of study, and in some cases this mark is of such a form as would seem absolutely impossible to produce with the means which are seen to make it. For example, Fig. 5 is a sketch of three gang mills cutting the spindle-box seat in a lathe head-stock; the mills are working simultaneously on five surfaces; on the surfaces marked *N* there were almost no cutter marks; on the surfaces marked *M* there was a very evident cutter mark, and what seems not only incredible but actually impossible, in the plan view the cutter marks were curved on the side *C* and straight on the side *B*. Here, then, in this small example of cuts, made all at once with an assemblage of cutters on a single arbor all working at the same time on the same piece, are the most surprisingly different surfaces resulting. These three mills were all cut spiral, and set with the teeth staggered on the arbor, so that each tooth had, it might be said, a time of its own on the work; but why no cutter mark at *N*, why curved at *C*, why straight at *S*?

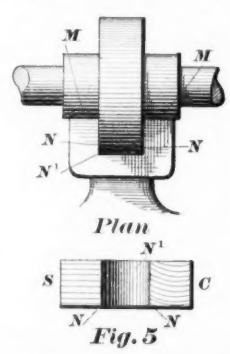


Fig. 5

This cutter mark is not very deep; marks that were very perceptible and looked deep, disappeared under one cut of the emery wheel in the grinding machine and under a very light cut at that, and where the mark was plainly noticeable it seemed to have very little actual depth. In the example shown in Fig. 5, however, the marks were of perceptible depth when the finger nail was passed over the surface. I also noticed on steel surfaces patches of marks, the surface on each side being smooth and bright, but these patches came in the same place in each piece of the lot.

The end milling machine, Fig. 6, is in the general form of a shaper, the work being held in a vise on the shaper knee as usual, and the end mill *M* being carried at the lower end of a vertical spindle in the front end of the ram, driven by means not shown, the ram having an outward feed motion. This is considered a very valuable form of the machine shop milling machine at Pratt & Whitney's. It is a simple and comparatively cheap tool, very convenient and quickly handled, and especially adapted to that large class of small pieces which require a flat cut on one side as an only, or the first, finishing operation.

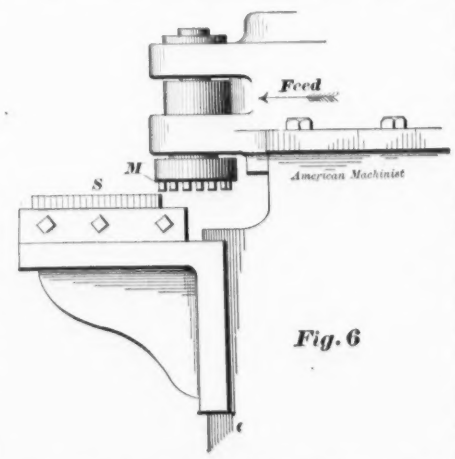


Fig. 6

This milling machine was using an inserted tooth-mill with taper pin keys, as will be shown in detail of mills 4¼″ diameter, 20 teeth, 60 revolutions per minute, with a feed of 2″ per minute, giving the following figures:

Feed per tooth, 0.0016 inch.
Speed per minute, 66 feet.

All surfaces finished on the shaper milling machine may, of course, be expected to be hollow in both directions or "dishing." If the mill spindle is not mathematically at right angles to the line of ram travel, then the cut must be hollow when tried across the line of ram travel; if the weight of the free end of the ram does not balance the resistance of the cut, then because the ram is constantly less and less perfectly supported as it advances outwardly over the work, the cut will be a hollow curve in the line of ram advance; if, however, the weight of the free end of the ram is greater than the resistance of the cut, then the end of the ram would drop as it was less supported in its outward travel, and the work would show a convex curve in the line of ram travel. I tried several pieces 2¾″ wide by 5½″ long milled on this machine the long way with the ram feed, on the surface plate and with a straight-edge and found them uniformly very perceptibly hollow crosswise and very slightly hollow lengthwise, indicating that the mill spindle was not exactly at right angles to the line of ram travel, and that the weight of the free end of the ram very nearly exactly balanced the resistance of the mill cut on this width of surface. As will be noted the surface speed of the mill was extremely high, 66 feet per minute on dry cast iron; the cut was light, only about $\frac{1}{64}''$ in depth, and the number of cuts per inch was very great, 600. That is, if every tooth of this mill made the same cut, then each chip measured, in its greatest section, $\frac{1}{64}''$ high by $\frac{1}{600}$ of an inch in thickness. As might be supposed with such slight rigidity of mill support and large factor of work stability the cutter mark was slight, and as the cutter made 30 revolutions to the inch, the marks had so little width as to be unnoticeable. The shaper mill spindle was short, thus enabling the insides of such pieces as lathe heads to be milled on it one face at a time with a small end mill; this work would require a very much larger mill if made the other way with a side cut.

An adjoining job was that of the small and medium lathe heads and the lathe spindle boxes, three milling machines run by one hand. One lot of 52 regular Pratt & Whitney engine lathe heads, 13″ swing, had just been put through these milling machines in 39 hours, each head having five large cuts on it. Last year there were 1,700 pairs of lathe spindle boxes milled on this job, ranging from 6″ square to 1¾″ square where they fit into the lathe head-stocks. These boxes were an admirable job, the junction of separate cuts in the same plane being absolutely perfect; the two halves of a pair of boxes are associated and numbered after the first cut is made, and they are operated on in pairs thereafter and are perfect mates, and also close driving fits in the lathe heads to which they belong; this whole job of lathe heads and boxes being done with a perfection and small labor expenditure which were surprising even to one familiar with the powers of the milling machine.

At the time I saw this job one of the machines (Pratt & Whitney No. 4 power milling machine) was finishing milling machine spindle box caps, sections shown in Fig. 7, with a gang of mills running 45 revolutions per minute; the larger of these mills was 3″ diameter and had 25 teeth, and the feed was 6″ per minute, giving the following figures:

Speed over 35 feet per minute.
Feed per tooth, 0.0053″.
Cuts per inch, 187½.

As is well known, Pratt & Whitney have put out machines in which circular work, or lathe work, was done with mills instead of lathe tools, and two examples of this work were in process of execution while I was at their shops. One of these was milling the rims of lathe change gear blanks; these blanks were bored and reamed, and the hubs faced off on the sides before they came to the rim milling machine—"circular milling machine," as designated by Pratt & Whitney. The rims are of section shown in Fig. 8, and are finished at one cut with a gang of 3 mills, 18 teeth in small mill, and 20 teeth in large mills, 52 revolutions per minute, feed 2″ per minute, if the iron is hard, and 3″ if it is soft; giving these figures, with 2″ feed:

Large mills feed per tooth 0.0019″.
Small mill feed per tooth 0.0021″.
Cuts per inch, large mills, 520.
Cuts per inch, small mill, 468.

At 3″ feed per minute:

Feed per tooth, large mill, 0.003″ nearly.
Feed per tooth, small mill, 0.0032″.
Cuts per inch, large mills, 337.
Cuts per inch, small mills, 312.

The work was done rapidly, and was extremely good, the sizes being, of course, exact, as was also the location of the rim with respect to the hub faces. One hand ran two of these machines, and the change wheels were made on a modified pillar machine, Brown & Sharpe index machine style; the other was a much larger and heavier machine, and was milling the face and flanges of a double-flanged pulley (section shown in Fig. 9), the flanges being milled outside and inside, with a gang of five mills, 28 teeth in the largest, and 22 teeth in the middle size, 3¾″ and 2¾″ diameter respectively, running 52 revolutions, with a feed of 2″ per minute, giving these figures.

For the largest mills, surface speed 51 feet per minute,

Feed per tooth, 0.0014″.
Cuts per inch, 728.

For the middle size mills, surface speed 37 feet per minute,

Feed per tooth, 0.00175″.
Cuts per inch, 572.

It will be observed that in the two jobs on the circular milling machines, which

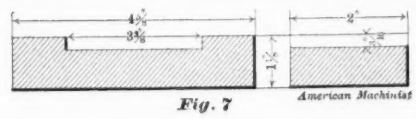


Fig. 7

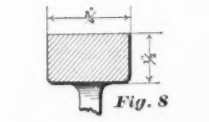


Fig. 8

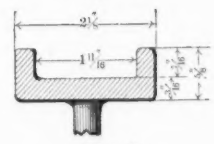


Fig. 9

were steady work, and in both of which the production was very much more rapid than could be produced with single tooth tools, there was a wide variation in what would seem to be essential features of action. Work of mills in circle milling machines, two examples.

FEEDS PER TOOTH.	CUTS PER INCH.
0.00192	520
0 0021	468
0.003	337
0 0032	312
0.00141	728
0 00175	572

The feeds per tooth range from 0.00141″ to 0.003″, and the cuts per inch, from 312 to 728. In explanation of want of uniform practice, it may be noted that the requirements of the largest mills in a gang are imperative; the surface speed and feed per tooth cannot exceed certain limits; this makes the large mills fast, and the small mills in the same gang slow, and gives a small feed per tooth to the large mills which have the more teeth, and a large feed per tooth to the smaller mills which have fewer teeth. The labor charge for work performed on the circle milling machine drops in cost per inch of finished work in proportion to the number of machines tended by one hand. It is only a moment's work to take one wheel out of the machine and put an-

other in, and one hand could easily run five or six of these machines, and in such case the labor charge for surface finished would fall to very low figures. Besides low labor cost the work produced by the circle milling machine has the vast advantage of a certain location of the rim and all its parts with relation to the hub faces. Thus in bevel or worm gear blanks, the hub faces and pitch cones, or worm shaft centers, are all respectively exactly alike, while with the very best work from the common lathe there are small differences in relative hub and rim positions, which make it needful to fit each bevel or worm gear to place by facing off the hubs, which are left full for that purpose; once given a correct model, and the circle milling machine produces work which will assemble without this special fitting of each wheel to its own place. It is clear that for interchangeable wheel work the circle milling machine is a very valuable tool, and one destined to have great use.

A Planimeter Improvement—Aluminum Bronze.

Just after the close of the sessions of the A. S. M. E., on Friday, the 8th inst., and before the members left the hall, two matters of interest were presented, which, not being upon the official programme, could not be presented during the regular meeting, though, so far as we can see, there could be no other reason.

One of these was an improvement in the planimeter, devised by Prof. D S. Jacobus, one of the improved instruments being exhibited by him. The improvement consists in doing away with the point for tracing the lines of a diagram, and substituting for it a small circular frame of brass, adapted to receive a small plain glass disk (about ½ inch diameter), which glass is so placed as to lie flat upon the paper or diagram to be measured. On the lower surface of this glass are two straight lines, drawn with a diamond, and crossing each other at right angles in the center. This point of intersection of the two lines is then the point which is drawn along the lines of the diagram, instead of the usual tracing point.

Any one who has had much to do with working up cards by the planimeter will readily see the advantages of this plan. The lines can be seen much more clearly and easily because no shadow is cast upon them and the light is always the same upon all parts of the card. The eye can be placed directly above the line being traced no matter from which direction the light comes, and finally, what is in some cases most important of all, the card is not grooved, marked or changed in the least, or in any way, so that the trouble arising from successive men following grooves made in the diagram by other men is avoided, and in fact it is impossible to tell whether or not a card has been traced.

Dr. Leonard Waldo, of 311 Broadway, N. Y., then presented to the members some specimens of what is called "Aluminum bronze," by which is meant an alloy composed of nearly 10 parts of aluminum to 90 parts copper. This it was stated was an alloy which could not be separated into its constituent metals again by any ordinary process, had 90,000 pounds tensile strength, with 15 per cent. elongation, will cast, forge, roll hot and cold draw into wire, work in the lathe about as good steel does, take a high polish, and does not readily tarnish. He pointed out that the difficulties in making most large castings had been substantially overcome, and that the bronze was particularly available for castings to replace complicated steel forgings for steel-tooled work where the labor was large. The bronze was stronger than the steel. "It was a mistake," the speaker said, "to classify the alloy of aluminum and copper among the bronzes. Such evidences as we possessed seem to show that a chemical reaction took place when aluminum is added to copper, and that the new compound was soluble in molten copper. There were reasons for thinking that the maximum effect of strength and ductility combined was obtained with an alloy of 10 per cent., and in order to distinguish this alloy from other alloys containing a less amount of aluminum, it was proposed to call aluminum bronze having 5 per cent. of aluminum or one-half the amount of the standard bronze alloy 'half aluminum bronze,' and so also a bronze containing one-quarter of the amount of the standard, 'one quarter aluminum bronze.'"

These grades have very markedly different qualities. The grades containing but little aluminum, possessing the higher ductility and less rigidity. They all possess a greater resistance to corrosive influence than any other commercial copper alloys.

Spoons were shown made of an alloy containing about 5 per cent. of aluminum, and called "half aluminum bronze," these appearing much like solid gold, and, in fact, being passed as such in some instances by jewelers. He expressed the belief that this bronze would prove to be exceedingly valuable in machine construction, especially in view of the possible cheapness of the metals of which it is composed, it having been shown, for instance, that copper could be laid down in New York at a cost of 6¾ cents per pound, and that aluminum could be made at a cost of 28 cents per pound.

At the conclusion of his remarks the members tendered to Dr. Waldo a vote of thanks.

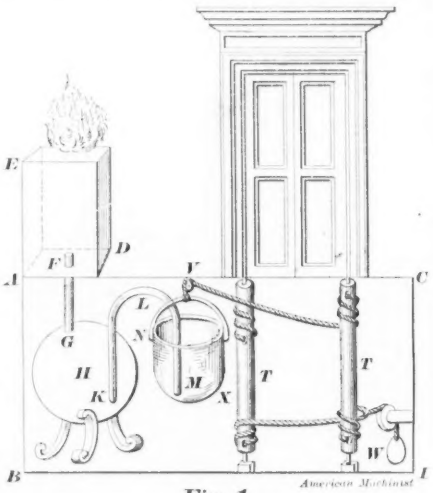


Fig. 1

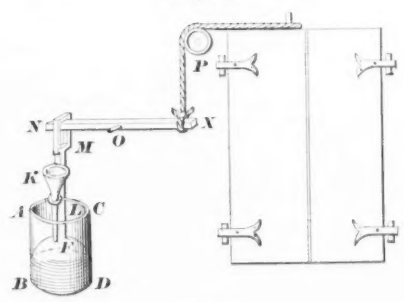


Fig. 2

Ancient "Sacred Sleight-of-hand."

BY W. F. DURFEE.

In Rockland, Me., last Sunday, a "sacred sleight-of-hand performance" was given.—*N. Y. Tribune, October* 27, 1893.

The above paragraph called promptly to mind some of the many mechanical jugglerries that were practiced in the temples of Egypt in ancient times, and as it appears that "sacred sleight-of hand" performances are being revived, it may be of timely interest to explain how the Egyptian priestly prestidigitating prestidigitator prestidigitated for the "sacred" purpose of impressing the ancient worshipers with an exalted idea of the power of that god whose temple he ventured with fear and trembling to enter, and it is not impossible that the ancient designers and managers of the machinery of the old temples may have known a trick or two which would afford valuable hints to the modern practitioner of "sacred sleight-of-hand."

I have already in these columns shown (AMERICAN MACHINIST, June 15, 1893,) how at the entrance of Egyptian temples "lustral water" was sold to the devotees (at the rate of nearly a dollar a "sell") by an automatic apparatus, which was doubtless the patriarch of the numerous tribe of "drop-a nickel-in-the-slot" machines, any member of which on the receipt of "a nickel" will promptly deliver a "barrel" (although "single-barreled" they are all "revolvers") of jangling noise (doubtless intended for "music") and possibly a "stick" of "chewing gum" or "taffy."

Having shown the way the ancient devotees were miraculously purified, and thus prepared to enter the temple, we will now give Hero's illustration (from Commondine's Latin translation from the original Greek, Urbini, 1575,) of the way temple doors were made to open spontaneously when the sacrificial fire was lighted upon the altar.

In Fig. 1 *E D* is a hollow metallic altar, from the base of which a tube *F* is extended downward and connected with the hollow metal sphere *H* at *G*, which sphere, when the temple doors are closed and the altar *E D* cold, is nearly full of water. Connected to the sphere *H* is the siphon *R, L, M*, the end *M* of which is within the bucket *N X*, which is suspended by a rope passing over a pulley *V*, and is then divided, each part being coiled around one of the vertical cylinders *T*, around the lower end of which other ropes are coiled in a reverse direction, which finally unite and pass over a pulley and connect with a lead counterweight. The upper ends of the cylinders *T* are connected with a spindle attached to the bottom of each leaf of the temple doors. All the connections of the pipe *F G* and the siphon *K, L, M*, with the altar and hollow sphere, must be air tight as well as the altar and sphere. All the machinery described is below the temple floor, and, of course, unknown to all, save the temple priests and attendants.

The apparatus operated as follows: When fire was kindled upon the altar *E D*, the confined air within it expanded, and passing through the tube *F G* into the space above the water into the hollow sphere *H*, it forced that water through the siphon *K, L, M* into the bucket *N X*, which, as it descended, turned the cylinders *T T* through the medium of the cords, and as these cylinders were attached to bottom of the doors,

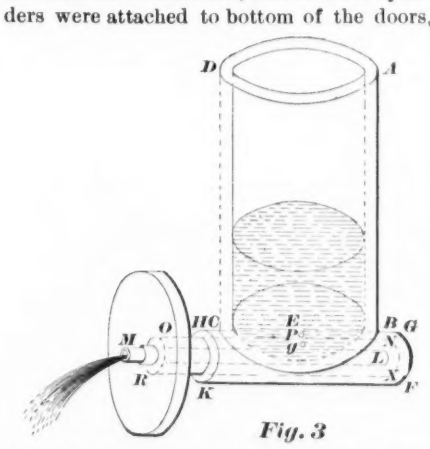


Fig. 3

they were in an apparently miraculous manner thrown wide open as the result of lighting the fire on the altar.

The doors were closed when the altar fire was extinguished by a reverse action of the machinery, for when the altar cooled the air contained therein contracted, thus reducing the pressure on the water in the sphere *H* somewhat below that of the atmosphere, and then the siphon *K, L, M* acted in the reverse direction and carried the water in the bucket *N X* back into the sphere *H*, and as this action took place the lead weight *W* asserted itself, and by turning the cylinders *T T* backwards by means of the cord to which it was attached, the temple doors were closed in quite as miraculous a manner as they were opened.

This apparatus evinces a high degree of ingenuity, and incidentally affords proof of the great skill attained by the Egyptians in the working of iron, for Hero states at the close of his description of this machinery that "some in place of water use quicksilver, as it is heavier than water." Now quicksilver could only be used when the whole apparatus with which it comes in contact was made of iron, for iron is the only metal not acted upon destructively by quicksilver.

I believe that this is the first time that the above evidence of the ability of the Egyptians to employ iron in the construction of mechanism has been brought forward. Whether the metal used in this instance was cast or wrought iron, we cannot be certain, but as the art of making castings in bronze was well understood, it is extremely probable that such difficult forms as the sphere *H* and bucket *N X* would have been made of cast iron.

Hero also tells us how the sound of a trumpet was produced on the opening of the doors of a temple. He says, "Behind the door [all the apparatus of this sort was, of course, out of sight of the uninitiated] let there be a vessel [Fig. 2], *A, C, B, D*, containing water. In this invert a narrow-necked vessel *F*, shaped like an extinguisher, with which let the lower extremity of a trumpet *K*, provided with a bell and mouth-piece, communicate. Parallel with the trumpet and fastened to it let the rod *L M* run, secured at its lower end to the vessel *F* and having at its upper extremity a loop *M* through which the end *N* of the lever *N X* passes, thus supporting at a sufficient height above the water the vessel *F* when the temple doors are closed. The lever *N X* must be capable of turning on the pivot *O*, and a chain or cord attached to the extremity *X*, and after passing upwards over the pulley *P* it must be fastened to the upper edge of the door. When the door is opened the cord will be pulled and cause the end *X* of the lever to rise, and therefore the end *N* of the lever will no longer support the vessel *F* by means of the loop *M*, and therefore the vessel *F* will descend into the water, and the air within it being compressed will pass through the mouth piece and bell of the trumpet *K* and cause it to sound."

Hero tells us that "in the porticos of Egyptian temples wheels of bronze are placed which can be revolved by those who enter, it being the opinion that bronze purifies. There are also vessels of lustral water from which the worshipers may sprinkle themselves. Let it be required to so construct a wheel that on turning it round water for sprinkling the worshipers shall flow from it.

"Behind the entrance pillar let a vessel of water *A, B, C, D* [Fig. 3] be concealed, having a hole *E* in its base. Underneath this base let a small tube, *F, G, H, K*, be fastened, having a hole coincident with that in the base of the vessels. Within this tube place another tube *L M* fastened to the tube *F, G, H, K* at *L*, and in this tube make a hole *S* opposite the orifice *E;* between these two pipes let another pipe be closely fitted, with a hole at *P* in the same place with the holes *E* and *S*. Now if the several holes are in one line the water in the vessel *A, B, C, D* will flow from the extremity *M* of the pipe *L M*, but if the *N, X, O, R* is made to revolve so as to change the position of the hole *P* the discharge will cease. Attach a bronze wheel to the pipe *N, X, O, R*, and whenever it is made to revolve water will flow from the tube *M*."

When the awe-struck worshiper had been purified by lustral water and revolving bronze wheels, and had passed into the inner court of the temple through the miraculously opened doors, while the sacred trumpet sounded a joyous welcome he was at once confronted by other wonders, which to his already excited imagination seemed in very truth supernatural. Before him was an altar on either side of which were statues robed in priestly vestments. Above the sacrificial fire writhed a brazen serpent which presently commenced to hiss, while its vibrating forked tongue and life-like movements of body, combined with the reflection of the fire from its jeweled eyes to make it a horrible suggestion of occult evil; as the altar fire began to wane, suddenly the inanimate statues commenced to replenish it by libations of some combustible fluid having the appearance of wine; strange sounds pervaded the air, wonders on every hand greeted his astonished and bewildered sight; gradually the altar statues ceased their libations, and the fire declined and finally ceased to glow; as it expired the brazen doors of

the temple closed with a terrible clang that echoed through the pillared corridors accompanied by a wail from the magic trumpet that seemed a last farewell to all earthly things. The light slowly faded away, and a terrible tangible darkness pervaded the temple; thunder began to roll and angry lightning shot athwart the ponderous gloom; the earth trembled, and the massive granite walls of the temple seemed about to fall; gradually the tempest passed, and as its lingering thunder subsided in the dismal distance, there appeared afar off a small spot of light, and as it nearer came it continued to augment in size and brilliancy until it dispelled the thick darkness and every detail of the grand temple—columns and capitals, paintings and sculpture—were revealed and made resplendent by its effulgent illumination.

In the midst of this glorious light appeared a face evidently superhuman and divine; its aspect severe, not unmixed with gentleness, and having a beauty not of this world. At the sight of the face of the god Osiris the worshiper fell, prostrated by an agony of fear, and immediately became insensible. When he recovered consciousness he was reclining in the shade of flowering vines in one of the public gardens of Alexandria.

Such was the example which the ancient Egyptian ecclesiarchs set for the "sacred" thaumaturgists of to-day.

Those interested in preserving mementos of the Columbian Exposition can, by inclosing a two-cent stamp to the Abbott Machine Co., 47 South Canal street, Chicago, Ill., obtain a fac-simile of the great check for $1,565,310.76 issued on Chicago Day.

LETTERS FROM PRACTICAL MEN.

Cams for Driver Brakes.

Editor American Machinist:

In your issue of November 16th you give an answer (566) to T-Square's inquiry for a method of determining the curve for the cams in "spread" driver brakes.

I wish to say that the method given there seems to be greatly at variance with the requirements of the case. In attempting to lay out a cam for a certain brake by your method I found that I had variations in power, in attempting to get 28,500 pounds ranging from 14,275 pounds to 34,875 pounds.

By the method given by Phelan in his "Air-brake Practice," presumably Westinghouse method, this variation is but from 26,750 pounds to 33,425 in the same example. By another method I get this lay out 27,025 pounds to 30,600 pounds.

By your method I find a radius of 35½ inches is hardly distinguishable from the irregular curve given thereby, while by the Westinghouse the curve has a radius of 14$\frac{1}{16}$ inches, and by mine I find 14⅜ inches is the proper thing.

The proper point of starting the problem is not when the brake is in the "slack" position, but when the shoes first strike the wheels. You start it in position of slack, and it will be found that the cams will drop from 2 to 3 inches before the pressure is applied if proper allowance is made for the jumping of the engine. If now the power of the toggle is figured for this position, what will it be by the time the shoes meet the wheels? Or what proportion of power should be allowed for to compensate for this?

Your assumption that the lift of the shoe in approaching the wheel may be ignored, and the work laid out in a straight line is a great mistake, for that little movement is of the greatest assistance in keeping the toggle angles similar and the variation in pressure at a minimum. As far as can be seen it is an impossibility to eliminate these variations entirely from the very nature of the functions of the cam. Could the cams be made long enough on the face so as not to require extensions to reach their labor without an undue amount of slack there would be no trouble in finding a curve that would produce constant pressures. But this slack must be reduced to a minimum or there will be a waste of air as well as a waste of frequently valuable time.

I will say that the best radius of curve obtainable is equal to the distance from the center line *H L* (Fig. 1) to a point midway between the center *C* when new shoes are in *contact* with new tires (particularly note *not* in position of slack), and same center when both shoes and tires are completely worn out.

I will shortly send you a method of laying out these brakes, which I have used with great success for some time past.

WM. HENRY FORD.

Feeding Milling Cutters Contrary to Common Practice.

Editor American Machinist:

So far as those who have reported their experience on feeding backwards in milling goes, the evidence seems to point conclusively to an advantage wherever the trial was successful. I am of the opinion there has been an equal number where they have not been successful that have not reported at all.

One might reasonably infer from what has been said that the main difficulty lay in preventing lost motion in the feed mechanism, while in the writer's opinion spring in the mandrel, machine and the work will be found a more troublesome element to deal with than lost motion. To overcome to a large extent both the troublesome features, the plan shown in sketches Figs. 1 and 2 is suggested.

The suggestion is for a slabbing machine pure and simple, with a table traveling between two posts. The table *A*, Fig. 1, has a skew vertical rack cut in each edge, with

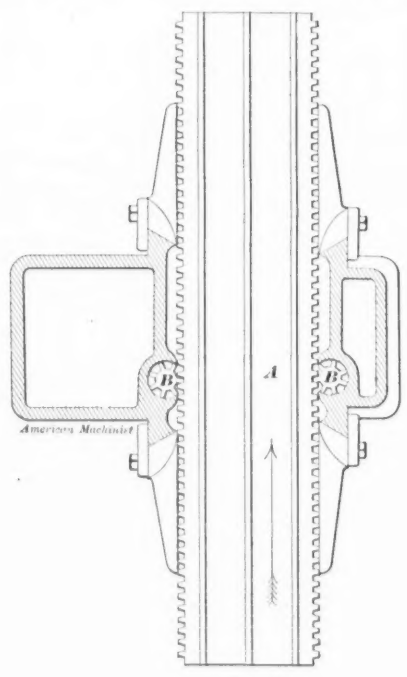


Fig. 1

spiral resistance pinions *B, B,* working therein, which pinions are constructed and controlled in the following manner: The pinions are long nearly vertical shafts, fitted in reamed holes, and have spiral gear teeth cut in them of sufficient length to allow for any required raise and fall of table, the ends of the teeth forming the bearings, the direction of spiral being such as will tend to hold the table down. By this arrangement, questions of spring in the knee, or give from loose slides, or from the work being above the abutment, is avoided to the greatest extent possible.

The pinions themselves being shafts of large size avoids torsion, and the bearing being larger than the pitch line, there will be great friction, so that the drive of the cutter will be against a practical dead stop or solid abutment all the time.

To drive the two pinions uniformly, or rather to compel them to offer equal resistance to the forward motion of the bed, the plan shown in Fig. 2 is suggested. *C* and *C'* show worm-wheels at the lower ends of the pinions, each driven by a worm *D* and *D'*, which are on a shaft that is free to move endwise for a short distance.

To admit of running the table back, the worms are to be thrown out of gear, or to stop the feed, the worm shaft is to be stopped, which leaves the table locked in position.

To feed the table an ordinary weight, gear or rack, or a coarse pitch screw may be used and fed by gearing that tends to feed quite a little faster than the resistance gearing will permit. By providing a friction wheel or pinion, slipping will allow for the difference.

The rack and pinion idea is shown in Fig. 2. The worm-wheel *E* is turned by a worm of the same pitch as the others, but the wheel being smaller, the vertical shaft tends to turn faster than *C C'*, but it cannot move the table faster than the pinions *B B'* will permit it to go; hence the necessity of securing gear *E* to shaft *F* by friction, which will slip after all slack motion is taken up. The same motion can be applied to a screw. The worm *G* would need to be feathered on shaft, and held between shoulders.

To avoid spring in mandrels, beyond what has been so far done, it is necessary to arrange so they can be as short as possible, and this calls for a movable head as in the Lipe machine, or main spindles large enough to take large sockets, which may extend out so as to carry short mandrels.

The cost of a main bearing 4″ in diameter by 6″ long cannot be so much less than one 6″ in diameter and 4″ long as to cut any figure in such a machine, and that likely is about the proper proportion for either lathe or milling machine main bearing. Such a shaft would take in a 3½″ or 4″ socket or mandrel, and offer a fair degree of rigidity for cutters of the same size.

Believing these points are pertinent to the question, they are offered for consideration and criticism, bearing in mind that this is not offered as a design for a milling machine, no thought being given to driving gear, dirt shields, arrangement for convenient manipulation, etc.

JOHN E. SWEET.

Milling Machine Feeds—Steel.

Editor American Machinist:

In the discussion now going on about milling, the opinions of the different writers are governed by their experience, or ought to be. Some of them appear to discuss it from a purely theoretical standpoint, and, of course, as is readily seen, the theory is all in favor of the new way. But the fact

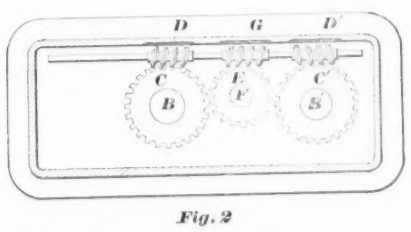


Fig. 2

is the direction of feed will depend at present, with present machines, entirely upon the character of the work, the machine, or both, and particularly the kind of metal operated upon, which particular I have not seen mentioned yet. The "new" way is, I think, particularly applicable to cast-iron, on account of its peculiar nature, and its hard, glassy surface, and destructiveness of reamer, and scraper edges, as compared with other metals For wrought iron or steel I do not think it makes any difference, aside from the fact that it is easier on the feeding mechanism, and is much more reliable in cutting straight slots with thin saws, as the teeth enter on the top, while it is a fact that the majority of saws cut slightly freer on one side than the other; this will cause them to run off. To cut from bottom of slot simply prevents the saw from correcting the error, as it is confined in the slot, and as soon as it has run the thickness of itself, it breaks, as may be expected. To use a hand reamer with oil, in cast-iron, will destroy the fine cutting edge much quicker than to use it dry, and will not improve the hole. But I would never think of tapping cast-iron without oil, in spite of my bringing up to the contrary.

In a recent issue, I noticed an editorial comment on the peculiar qualities of steel used in the manufacture of projectiles, and its supposed superiority over the steels of commerce, which I have fondly imagined were made by men who know as much about steel making as any body living. I will mention two firms that I think know something about steel, William Jessop's Sons, and the Crescent Steel Company, one is foreign and the other domestic. I like both kinds, have used them a great deal, and swear by them. Patriotism in this case cuts no figure, and should not in any similar case.

On the brick battleship "Illinois," I saw a wrought iron plate 4 inches thick that had been pierced so many times, that it looked like an unusually heavy sieve—the holes were all smooth, as though machined, but probably not as true. On the back of the plate the metal was curled outward like a heavy pin, the projectiles that had pierced the plate were also there, apparently in perfect condition. One of them had been fired through twice, and it could not be told from the others except by the double corrugation of the copper ring at rear end, caused by the rifling of gun, they were 4 inches diameter by about 10 inches long. One of them had the side cut away to show section. It had every appearance of being a steel casting, it was hollow—about a 2-inch case—and had every evidence of being soft, the points were flattened about ⅛ inch, and none of them bore any evidence of having hit anything hard. I have seen a candle fired clear through a ¾ inch pine board, but never could see that it argued anything for the quality of the candle, it was a "regular" candle, and it made a very "irregular" hole, but it went "through."

H. H. HARDINGE.

American vs. English Locomotives.

Editor American Machinist:

We frequently see it claimed by the majority of technical papers published in the United States that the American locomotive is, in every respect, a superior machine to the English one.

This may or may not be the case and is, in my opinion, entirely controlled by the conditions under which the different engines have to be worked.

It is very refreshing and not a little amusing to see the pronounced attack of anglomania that struck the authorities in charge of the locomotive department of the Pennsylvania Railroad, when they produced their new T-class compound, which is decidedly English in its leading characteristics and general appearance.

For instance: The usual American tender run on two 4 wheeled trucks has been superseded by the regular 6-wheeled English tender with a rigid wheel base, which latter is said, by Pennsylvania Railroad engineers, to ride the easier of the two.

Second: The valve motion is direct acting, the essentially American rocker arms having been dispensed with, and,

Thirdly: The usual American type of running board has been entirely abolished and substituted by English foot-plates and splashers. Note also that engine truck and tender wheels are 42 inches in diameter, and that the sand boxes are contained in the wheel splashers—a very English feature.

What reason can you advance to show why this very important and very progressive American railroad has adopted decidedly English points in the design of their latest locomotives unless they are convinced that they are superior to the American ideas, which they have had hitherto in vogue?

It would be very interesting to all your readers if you were to publish illustrations and descriptions of this new engine, which was designed by Mr. Theodore N. Ely, and recently built at the Altoona shops of the Pennsylvania Railroad.

ONE WHO SERVED HIS TIME IN AN ENGLISH RAILWAY SHOP.

Fly-wheel Accidents.

Editor American Machinist:

The frequency with which these so called accidents happen is somewhat alarming, for usually the reports that we receive of them assign no cause for the disaster, but rather give the idea that some mysterious agent is at work, and that it is impossible for us to tell what the cause of the trouble is. A few years ago there was much mystery about boiler explosions, but owing to the persistent efforts of a few experts who believe that there is a plain cause for the failure of every steam generator that refuses to do duty longer, we now see that although it may have been nearly impossible under ordinary circumstances to have discovered the hidden defect which caused the explosion, still for every effect there is a cause, and it only remains for us to discover the defect before it is too late. Up to two or three years ago, we very seldom heard of the bursting of a fly wheel, but although the number of engines in u e has increased very fast, still it appears that the number of accidents has increased much faster, and, furthermore, we notice that many of these are on new engines comparatively, or else on those which have been rebuilt, and their speed increased.

In an accident at Memphis, Tenn., the wheel was 11 feet 6 inches in diameter, and revolved 152 times per minute. This gives us a velocity at the rim of over 91 feet per second. Now Haswell tells us that the maximum safe velocity of fly wheels is 80 feet per second. It is but fair to assume that this statement is based on the results of experiments made for the purpose of giving us some light on the subject, and such being the case, if we run our wheels much faster than this, is it not inviting disaster? After the affair at Memphis was over, and the lifeless body of the engineer had been removed, several experts examined the remnants of the broken wheel, pronounced the iron of good quality, without flaws, and the verdict is that no one can tell the cause of the catastrophe.

I do not claim to know the immediate cause of the failure of these wheels, but in every case that has come to my notice this maximum safe limit, as quoted above, was exceeded at the time of the failure, and it appears that this fact in itself is strong evidence that the safe limit has been exceeded.

If we call the attention of owners or superintendents to their wheels which are running faster than they should, we shall probably be told that "Smith, Jones & Co. are running their wheel as fast or a little faster than we are running ours, and it appears to be in no danger." But by-and by Smith, Jones & Co. have an accident, and pieces of their fly-wheel go out through the roof of their engine room, but the beforementioned owners or superintendents are very slow to note the conditions, and are slower still to reduce the speed of their own wheels.

If the limit of 80 feet is too low a maximum speed, then will some expert inform us of the fact, and also how he arrives at such a conclusion? So far as I am able to judge at the present time, the following is the way that the speed of many engines is determined: A dynamo, or some other fast running piece of machinery, must be run at a certain speed. No countershaft is to be used, consequently the fly-wheel must be run fast enough to give the required speed, or perhaps one countershaft is allowed, and the engine must be run accordingly. If a certain engine builder objects to such a speed, it is an easy matter to find another one that is anxious for the contract of furnishing the engine, and so will take the chances on it.

A certain manufacturer wanted to have a larger cylinder put on his engine, and applied to an engine builder to do the job, but it was declined. It was referred to a second party, who also declined it, but a third one was willing to do it, and consequently it was done; but if an accident occurs on account of it, there will always be some one to decide that the affair was a mysterious dispensation of Providence, and the verdict will be that nobody is to blame. It is proper to adopt modern ideas, to keep abreast of the times, and to get all that we can safely out of our machines; but there are limits concerning which the declaration, "Thus far shalt thou come and no farther," should be made, and the sooner that we give heed to it the sooner will these accidents grow smaller in number and less disastrous in character. W. H. WAKEMAN.

Drawings or Models—Fine Measuring Instruments—Precedent in Machinery—Mechanical Processes.

Editor American Machinist:

To appreciate the position of a man who prefers a model to a drawing, it is necessary that those who can read a drawing should endeavor to picture to themselves the condition of a man who cannot see in his mind the article he wishes to represent. Is it not a fact that, before a draftsman puts anything on paper, he has first a more or less good picture of it in his mind? The drawing is only a record of his mind's picture. He sets down the picture on paper, and thereby fixes its parts, and gives accurate dimensions to these; but the drawing, after all, only stands for the article represented, in the way these words represent my ideas. Before these written words meet the eyes of readers, they will be translated into printed characters, and the reader will retranslate them by his eye to gain the intention of the writer. Similarly, a drawing only represents an object to an eye that can convey an impression to a brain which is capable of picturing the object. Those of us who are still more versed in reading drawings, very frequently stop short in this process of translating simply from experience. Such use a drawing as a mathematician uses algebraic symbols—to attain a certain end through a number of processes and results, none of which are given any material value. A long series of equations are worked through, but the value of the unknown x is only ascertained at the conclusion, and so in a drawing we may use it algebraically and need not be continually picturing to ourselves the model form. A model would prove very inconvenient in practice. The dimensions could not well be put on it, and its own material dimensions could not be accurately and rapidly ascertained; nor, if of large size, could a model be turned over and seen through, in the way we see the dotted lines at the back of the drawing. If those who find drawing a difficulty will endeavor to see the actual article in their mind, the difficulty of drawing will vanish.

Everything is admissible upon a drawing which will render it clearer to read. Some people consider shade lines to be wrong, because they cannot be well scaled to. Now, as a rule, a drawing all shade lines—I mean, of course, a strongly lined drawing—is best, and yet such a drawing cannot be scaled. There are numerous places where a shade line is useful; it may render unnecessary the looking at the other view of an object for example. We do not want drawings to scale, but to indicate boundaries and directions to which figures give a value, to show materials and to indicate machining.

Of course, the making of a model is, as Mr. Lawrenz says, useful when getting up jigs.

Regarding Professor Reuleaux's remarks respecting fine measuring instruments, I think it well to say that the status of a country can be pretty accurately judged by its productions. One sometimes reads in American papers that the position of this country in mechanical engineering has fallen very low, and yet the "Campania" and "Majestic" can occasionally be seen in American waters by way of samples.

Regarding American fine measuring tools, it has been my privilege during the past few days to see samples of American tools which are being offered for sale in this country. I cannot, of course, mention names in the columns of the AMERICAN MACHINIST, but I would like to say that for finish and neatness and little details of value in attaining speed and accuracy they are fairly perfect. I believe they will have a good sale over here: it will not be lack of merit in either the tools themselves or the gentleman who is over here with them if they do not.

There are certain designs and methods which seem to be so far ahead of all others that they finally become universal. This thought presses upon one in considering the numerous types of gas engine. The Otto cycle was undoubtedly at the bottom of the success of the Otto engine as made here, and also in Germany and America. Very many other engines have been brought out and made, some of them in large numbers and with fair success, but few have the simple appearance and general build of the Otto; and now that the Otto patent has expired and any one can build to it, I notice that the Otto cycle is being very generally adopted. Indeed, some of the most successful rivals of the Otto engine have now taken up this construction preferably to their old designs. There was a man once who brought out a square wheel for railroad cars for which he claimed advantages, but the round wheel survived, and there are numerous similar instances of methods beyond which no one seems able to advance. For instance, the locomotive of to day differs less from the earliest practical machines than do different products of nature herself, as the dog or horse. Hence in seeking for an improved method of doing anything, it is well before completely revolutionizing previous machines to carefully study precedent and make sure that before we depart from this the precedent is not one of the above kind—fixed and unalterable. No one has yet been able to produce a spinning machine to do the best work except upon the lines of the old hand method of spinning, and the modern spinning frames which follow other lines owe success rather to the perfection of preparation machinery than to any inherent virtue of their own. In manufacturing processes, the principle of graduation seems almost essential to economy and excellence. We find it in mechanics where a piece weighing a few ounces goes through twenty processes before it is complete.

In cotton spinning, the final yarn contains in itself ten times as many reduplications as there are natural fibers in its cross-section. Wheat grinding by one pair of millstones has been killed because it could produce neither quantity nor quality with gradual reduction processes, and the same applies to the grinding of other substances. It is, I think, an essential element in reducing materials to dust that all dust formed should be removed as quickly as possible, and the coarse remainder continued in treatment, but it should never be expected from any machine to turn out dust when it is fed with nuts. The difference is too great, the power absorbed is excessive, and the machine which can produce the required dust is too costly to be used for the earlier rough breaking down processes.

It would appear that the above principle is only applicable to material things. When we come to less material things, directness proves more economical. The conversion of power into electricity is one of the most economical processes known, *via* the dynamo, which, with one moving part only, has an efficiency of not far from 100 per cent. That class of turbine of which the American Pelton wheel is an example, has the highest efficiency of any, and is the simplest. Examples might be multiplied. In our practical work we have got to consider with which class of processes we have to deal, and then act accordingly.

W. H. BOOTH.

Cross-section Paper.

Editor American Machinist:

I have just read in your issues of last spring some inquiries for sectioned paper. This paper is made in England, but the best I have come across is to be had from Messrs. A. Lepage & Cie., 3 Rue des Deux Boules, Paris, France. It is sold in rolls of two feet wide and about 24 feet long and ruled in two colors "bistre" and "bleu." The "bistre" color is usually preferred, being of a warm tint.

For expedition I prefer plain paper with a T-square, but for sketching machinery to scale or full size the ruled paper is very pleasant, the only tools required being a roll of paper, pencil, pen and rubber, bow pencil and a Brown & Sharpe protractor. Sketches may thus be executed in a hotel whilst traveling. T. S. KENNEDY.

Parkhill, Wetherby, Eng.

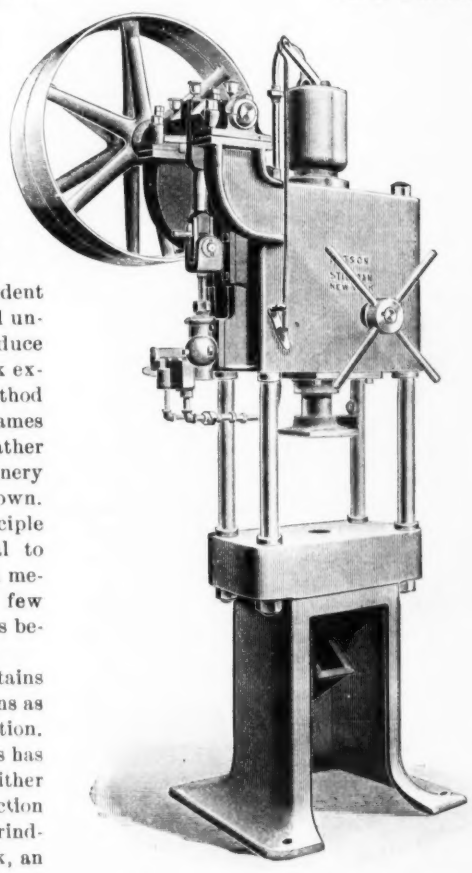
That Boiler Explosion.

Editor American Machinist:

I notice letter in last issue from Mr. Orosco C. Woolson in regard to my article on the Dry Dock & Battery Railway Company's boiler explosion.

He states that he thinks the combustion chamber was not so long as I state; it may have been a little shorter, but that did not affect my opinion as to the cause of the explosion. In regard to the bracing, the boiler was braced as usual at heads, etc. I did not show the braces as it was not necessary.

A. R PAYNE.



Hydraulic Broaching Press.

The illustration accompanying this is of a light hydraulic broaching press with attached pump. The hand-wheel, which is to be seen in front, is upon the end of a shaft, bearing a pinion meshing with a rack cut upon the ram. With the release valve open the ram can be quickly run up and down, entirely independent of the pump, the pipe and valves being extra large to permit of quick and easy motions. In operation the throwing of the small lever at left of the hand-wheel puts the pump into or out of action. The pump is double acting and provided with safety valve and easily reached valves, covered with metal-seated bonnets. The ram is counterbalanced, so that it cannot drop down. The lower platen has a small hole through the center. An adjustable pocket, lined with wood, catches the broaching tools as they drop through, and, by its special shape, throws the upper end forward so that it can be easily taken hold of.

The 30-ton press has a platen 18x13 inches; vertical space, 13 inches; hole in platen, 2x3 inches; from the floor to the top of the power platen, 33 inches. The belt pulleys are 30x4 inches and should run at about 100 revolutions. Total height, 7 feet 6 inches; plan area, 32x34 inches; weight, 1,600 pounds. It is made by the W. & S. Hydraulic Machinery Works, 204–210 East Forty-third street, New York City.

AMERICAN MACHINIST

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The Economy of Skilled Labor.

The benefits which result from the employment of skilled mechanics—mechanics who not only know how to perform manual labor, but who can think and are in the habit of thinking, were perhaps never better set forth than we find them in a report presented at the last meeting of stockholders of the Mergenthaler Linotype Co. It is the more significant from the fact that it was made not for general circulation, and for no other purpose, so far as we know, than to place before the stockholders of the company the status of its affairs and the reasons for the improvement that had been brought about with respect to them. We quote from the president's report as follows:

. . . "The new Brooklyn factory has been completed and fully equipped with an extensive plant of machinery, fittings and tools of a superior character. The old factory has been improved in various particulars, its machinery in part rearranged, and additional machinery introduced. Of the new machinery placed during the year a considerable portion was designed and built within the factory to meet the peculiar requirements of the business. Special care has been exercised in purchasing, building and arranging the machinery, in order to secure a rapid and economical output and the production of superior machines. The shop methods have been modified and improved in many ways looking to reduction in the cost of manufacture, and the machine has been improved in many minor particulars. The workmanship is now so perfect, and the system of shop inspection so rigid, that machines are ordinarily erected and put into operation in the printing office in one day. It is a rare occurrence for the company to be subjected to any expense in starting the machines after they leave the factory. This fact alone is a striking evidence of the advance which has been made, as the cost of erecting and starting machines during the last year of the old company was very great, amounting in many instances to a large proportion of the present cost of building them. At the present time the total cost of labor and material in producing a machine is less than half the amount which was paid in 1891 for labor alone. With about double the number of workmen employed in 1891, the company is now producing machines at five times the rate which then prevailed, besides furnishing matrices and supplies for the much larger number of machines in use.

"The present production of the factory is now 50 complete machines per month, and this can, in a reasonable time, be increased to 60, with a small increase in the number of employes. It must be noted that the factory also manufactures supplies for all machines in use, and the matrices and spaces for its own machines as well as for those manufactured under contract by Mr. Mergenthaler."

And in another portion of the report the president and manager, Mr. Phillip T. Dodge, shows that he does not hesitate to give credit where it is due, for he says:

"The excellent results attained in the factory are largely due to the energy and ability of Mr. Randall, the general superintendent, and Mr. Pentz, the mechanical superintendent. To the foremen—Messrs. Connor, Bedell, Sytz, Hastings, Soper, Lamphere, Brock, and Gregory—and those under them, the company is also indebted for the fidelity and zeal manifested in carrying out the work in their respective departments."

The statement that the total present cost of both labor and materials is less than half the former cost of labor alone, is very significant, and may be surprising to all but those who are somewhat experienced in the matter of management of manufacturing operations; to these latter it will not be surprising, because similar economies have been and are constantly being effected by the employment of highly skilled labor. Mr. Randall, the general superintendent referred to, is a well-known mechanic, and Mr. Pentz is our Mr. A. D. Pentz, who has contributed valuable matter to these columns. We have not the pleasure of acquaintance with Mr. Dodge, but we have never known of a manager of a manufacturing enterprise, who showed such a readiness to freely credit others with their good work, who did not at the same time possess unusual ability in his own line of work.

A Machinist as a Swell Boarder.

Plainfield, N. J., is, in many respects, a very nice town—one of the suburbs of New York and a favorite place of residence for men doing business in the city. It also contains some machine shops, in which machine tools and printing presses are built.

A considerable proportion of the inhabitants of the town are wealthy, while another considerable proportion are not wealthy but have a consuming desire to appear so—living much beyond their means and paying no bills they can possibly avoid paying—and some of them have developed wonderful science in evading collectors. A portion of this class of people live in stylish boarding-houses, not usually by preference probably so much as from necessity.

A machinist got into one of these boarding-houses recently, according to a report in a local paper, and came near wrecking the institution before he was unmasked and his real character known. He is described as a young man, affable, courteous, refined and educated—in short, possessing all those qualities which are popularly supposed to admit one to good society, and he became a favorite with the other boarders, until, like a thunder clap from a clear sky, came the discovery that he was a *machinist* actually working in one of the shops of the town. Naturally the other affable, courteous, refined, etc., boarders immediately "kicked"; they would have no machinist sitting at table with them, and his affability, courteousness, etc., counted for nothing. Unless the landlady got rid of that machinist they would all leave; so there! Not being able to formulate any specific objection to the machinist the landlady had to resort to raising the price of his board. This she did until $21 per week was reached; which our affable, etc., machinist paid without a murmur. Now the fact that he paid this amount for board, which was probably considerably more than any of the other "gentlemen" or "ladies" could have paid, should have made them suspect that something wrong, but they seem to have taken no hint and rushed on to their own undoing. Finally since raising the price of board seemed to have no effect the machinist was informed that his room was wanted; he got out and the dignity of the boarding house began to recover its wonted degree of impressiveness.

But shortly after the young man became located in his new quarters it "leaked out" that he was no ordinary machinist at all, but was only masquerading as such, being in reality the son of one of the proprietors of the large shop in which he worked, able to pay "$100 per week for board if it had been required," and working in the shop only to acquire that practical acquaintance with the business which would be of use to him as the prospective successor of his father.

The paper adds, "The chagrin of those to whom he was objectionable can better be imagined than described." We should say so. But then on the other hand imagine the chagrin of the young man when he discovered the real reason for his banishment from that company of swell boarders—real "ladies" and "gentlemen" themselves, of course, and so appreciative of gentlemanly qualities in others.

We will wager that any young man applying for board at that swell boarding-house now and announcing himself as a machinist will be received with open arms and given the best place at the table, whether "affable, courteous, refined and educated," or not; because you see he might be a son of one of the proprietors and an acquaintance with him might lead to a position as shipping clerk, timekeeper or some other equally genteel occupation in the establishment at a salary of $7 a week.

Politics and Machine Shops.

We have upon previous occasions pointed out that while proprietors of machine shops and their employes, as citizens of this country, should have convictions upon political matters and should act upon them as citizens, it is very poor policy for them to mix their politics with their business of building machinery. We have said that we do not believe it is good business policy, for instance, for a manufacturer to organize amongst his employes a campaign club, or to encourage such an organization. The reason for this being that it is our belief as a result of considerable observation of such matters that the active and usually acrimonious discussion of politics brought into the shop thereby is always expensive, and very apt also for certain very apparent reasons to produce the opposite effect from that intended to be produced.

In every case where a machine shop or manufacturing concern has been made a continuous political mass meeting or caucus, we are convinced that the cost in money, time wasted, and reduction of efficiency would, if capitalized and invested by the proprietors directly or through campaign committees in literature calculated to instruct and set men thinking, do far more good for the cause it is desired to advance, to say nothing of the fact that a shop largely given over to politics usually in the end leads to an infringement of personal and civil rights, severely condemned by public sentiment regardless of party lines, and which is inevitably injurious to the shop. Public sentiment always approves of a man's standing up fairly and squarely for the political policy or party he believes to be right or nearest right, but it always condemns whatever has even the appearance of denying to other men the same privilege.

In our issue of December 4, 1890, discussing this matter, we said:

Let Mr. Smith, of the firm of Smith, Jones & Co., take such political action as seems to him proper. Let Mr. Jones do the same. But as a company organized for the manufacture of machinery, let them see to it that no political action is taken by them, and that their only business is the manufacture of machinery, and the making of money thereby if possible. Most of the men employed will take their cue from this, and keep their politics separate from their work. Those who do not may fairly be given to understand that that is what is required. Machinery has no political complexion.

Not only do we believe this to be the best policy with regard to the business interests involved, but we believe also, that an employer does the most effective work for his own political party who does it entirely outside of, and without any connection whatever with his shop.

There are many indications that within the next few years there are to be some political struggles in this country, which, for intensity and partisan bitterness, have seldom, if ever, been surpassed. Our interest in, and friendship for, the men who work in machine shops, either as employers or employes, prompts us to express the hope that no part of that struggle will be carried on within the shop doors, and that none of the bitterness will be allowed to enter. It is out of place there, and can do nothing but harm to all concerned.

This was written because, aside from our own personal interest in, and desire for pure politics, we have a special interest in machine shops and in the men who work in them. We have reason to believe that the advice then given was recognized as sound and generally acted upon; we hope the time will speedily come when there will be no exceptions to the rule of entirely excluding politics from shops so far as possible both by employers and employes.

What constitutes a brain worker is said to be a question that has been agitating the minds of some men who proposed to organize a Brain Worker's Union in New York. One delegate claimed that a politician was not a brain worker, for he needed only "a brazen face and plenty of poor cigars." A wood carver claimed that those who followed his trade were brain workers, because no one could learn that trade without exercising his brain. Another delegate claimed that wood carvers were not brain workers because they used their hands, but

then it was pointed out that if non-use of hands decided the matter, watchmen, car starters and elevator starters would be classed as brain workers.

So far as we know, the question has not yet been decided, but it is an interesting one at any rate, and when it has been boiled down it will probably be concluded that it is a very difficult matter to decide. For instance, shall we place the draftsman among the brain workers, or among the hand workers? He always uses his hands, and usually his brains, if he happens to be the fortunate possessor of that article, and some draftsmen who commence the business as hand workers solely, eventually learn to use brains, and it would be difficult to say just when they cease to be hand workers and become brain workers. Nearly all mechanics, however, that are real mechanics use brains—use them more than most of those holding clerical positions, where the hands are used very little, and the fact is that the term brain worker is very indefinite.

A movement has been initiated in Congress looking to a reorganization of the navy in some respects, especially in the force of line officers. Such a reorganization seems to be needed badly enough, and we shall hope that in such a reorganization the fact will be recognized that naval vessels are now machines, and that the engineers who must manage them should at least be given sufficient authority to enable them to control their own departments; at least sufficiently to know that when they place a man in a certain position to do certain work, he will not be removed without the knowledge of his superior officer, and simply upon the arbitrary order of a line officer absolutely ignorant of the consequences of his removal.

Private establishments could never be run on any such principle as that which obtains in the navy, and the navy stands it only because the people can be taxed without limit to pay for it.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(613) W. C. R., St. Johnsbury, Vt., writes: Please inform me how I can drill a hole in a piece of gold quartz $\frac{3}{8}$ inch thick; the hole is to be about $\frac{1}{16}$ inch in diameter. I can make little or no impression with a common drill. *A.*—Use a diamond drill.

(614) C. J. H., Peterboro, Canada, writes: Please inform me at what speed I should run a boring head for boring a hole 85 inches in diameter and 18 inches deep. There are five cutters in the head; the feed is to be $\frac{1}{16}$ inch per one revolution. The material to be bored is cast-steel. *A.*—With good lubrication the speed of the cutter may be from 15 to 18 feet per minute, which is equivalent to running the bar at 0.67 to 0.8 revolution per minute.

(615) N., Philadelphia, Pa., writes: Please let me know if a patent can be obtained for making a certain article of a different material from which it has ever been made before, the use of said material greatly enhancing the usefulness of the article and at the same time making it more durable. Now it is not the article itself which I wish to have patented, neither is it the composition of the material used, but simply the discovery of making the article from this material. *A.*—We do not think you can obtain a patent under the conditions named.

(616) M. M. A., Lawrence, Mass., writes: Please inform me as to which of the following motors will be the cheapest for running a small machine shop, in which 3 to 6 horse power will be needed: steam, electric, gas, or petroleum motors. *A.*—The choice of motor will depend on so many things that it is difficult to advise you correctly. The best course for you to pursue will be to write to the different builders of the motors and get their price and a guarantee of what the motors can do, and then ascertain the cost of running the motors in your locality. 2. I think there are firms in New York and Chicago who manufacture petroleum motors for marine use, but I do not know their address. Some small cheap motor from $\frac{1}{4}$ to 1 horse-power will do at present. *A.*—The Gas Engine and Power Company, 131st street, New York, manufacture naphtha engines for marine purposes. We do not know anything of the merits of the electric motor to which you refer.

(617) F. G. H., Columbiana, O., writes: Kindly inform me how mitis steel castings are made. Is there any literature on the subject? Which do you consider to be the best book treating on cast-steel? *A.*—The mitis steel castings are made by a crucible steel process, of which there are several varieties. The process for making mitis steel castings we believe is patented, so it will be of no use to you. You will, however, find the most important varieties of the crucible steel process described and illustrated in "Metallurgy of Steel," by H. M. Howe, which we believe is one of the best books treating on this subject. 2. How are marine engine shafts forged hollow? *A.*—A hole of suitable size is bored throughout the center of the unforged ingot, and then forged to size over a solid mandril. 3. How was the hole made—which was scarcely visible to the naked eye—in the steel rod shown at the World's Fair? *A.*—You should have stated in which section you have seen it. We do not remember of having seen such an exhibit, and without further particulars are unable to answer your question.

(618) A. S., Philadelphia, Pa., writes: Kindly inform me what ingredients are used in the manufacture of India rubber. *A.*—The composition of India rubber usually consists, first, of a mechanical mixture and afterwards of a chemical combination of caoutchouc with other ingredients, such as lamp-black, red oxide of mercury, silica, pulverized pumice, etc., the latter are used as coloring matter, and as adulterants. To these ingredients is also added—and thoroughly mixed with them—a percentage of some vulcanizing agent, usually sulphur, varying from 4 per cent. and upwards, according to the degree of hardness desired and the temperature at, and the time in which it is desired to vulcanize it. 2. Can the rubber be molded into any shape? *A.*—Yes; full instructions in molding and manipulation of India rubber are given in the series of articles on "Rubber Pattern Work," by John T. Usher, which appeared in our issues of October 15, December 17, 1891; February 18, March 17, May 12, October 6 and December 1, 1892. 3. Can one part be soft and pliable and another of a stiff and harder nature in the same mold? *A.*—An article of rubber, one or more parts of which shall be soft and pliable and the remainder hard, can be made by placing packing in the mold containing a small percentage of the vulcanizing agent, which will vulcanize soft. In those parts of the mold where it is desired to have the parts flexible, the remainder of the mold should be packed with rubber, containing a larger percentage of the vulcanizing agent employed, which will vulcanize hard. The line of demarkation between the hard and soft rubber will depend entirely on the care with which the mold has been packed, and the amount of flexibility of the soft parts will depend on the degree of hardness to which the soft rubber vulcanizes, and the thickness and the density of it. 4. Are there books treating on this subject? *A.*—"Caoutchouc and Gutta percha," by Brannt, and "Rubber Hand-stamps," by T. O'Conor Sloane, published by N. W. Henley & Co., 150 Nassau street, New York, are good books.

(619) E. J. M., Elizabeth, N. J., writes: Kindly state whether you have discussed the strength of V and square threads for steel, brass and other metals. If not, kindly give an explanation of the following problem: A brass nut is screwed on a steel column—it has to withstand a pressure of 12,000 pounds. The diameter outside of threads is $3\frac{1}{4}$ inches, number of square threads 3 to 1 inch (single), depth of the thread $\frac{5}{16}$ inch, which will make the diameter of screw at the bottom of thread $3\frac{3}{16}$ inches. Now what I would like to know is: How many threads must the nut contain to withstand the given pressure with safety? *A.*—We have not published any articles treating on this subject. Instead of computing the strength of thread, we believe it to be more satisfactory to compute the number of threads required for preventing an excessive pressure per square inch of thread so that there will be no grinding between the metals. If this condition is met, the threads will be amply strong for the work the nut has to do. The pressure per square inch of thread should not exceed say about 700 pounds. To satisfy this condition, the number of threads should not be less than that found by the following formula, which has been taken from "The Constructor," by F. Reuleaux:

$$n = 0.0014 \frac{P}{\pi d_1^2} \frac{d}{t} \left(1 - 3 \frac{t}{d}\right),$$

in which d = diameter outside of thread, d_1 = diameter at bottom of thread, t = depth of thread, P = total pressure on screw acting in the direction of its axis, and n = number of threads. Substituting for the symbols their values, we have:

$$n = 0.0014 \times \frac{12{,}000}{3.1416 \times (3\frac{3}{16})^2} \times \frac{3\frac{1}{2}}{\frac{5}{32}} \left(1 - 3 \frac{\frac{5}{32}}{3\frac{1}{2}}\right),$$

which gives us a little over 11 threads in the nut. 2. If two nuts are used, must the two together be made higher than the single one? *A.*—When two nuts are used one of them should be made deep enough to contain as many threads as computed above; the other nut should be considered to be a lock nut; its depth should be equal to half the diameter of the outside of the thread. 3. Is there a formula for computing the thickness of cast-iron hydraulic cylinder walls? *A.*—Yes. See answer to Question 214 in our issue of April 27th, current volume. 4. Have you given any illustrations and details of pneumatic riveting machinery? *A.*—No.

(620) J. H. B., Youngstown, O., writes: How can I compute the deflection of a fly-wheel shaft shown in Fig. 1? The shaft is 12 inches diameter; distance between bearings, 10 feet; length of bearings, 18 inches; hub of fly-wheel, 30 inches in length; weight of fly-wheel, 50 tons, the fly-wheel being placed in the center in one case, as shown in Fig. 1, and in another case the fly-wheel is placed close to one of the bearings, as shown in Fig. 2. I would like to know how to compute the deflections for wrought-iron and steel shafts. *A.*—In cases of this kind we believe it to be the best practice to compute the deflections under the worst conditions in which the shaft and wheel could be placed, hence we shall assume that through some cause the center of the hub of the fly-wheel only bears on the shaft. Under

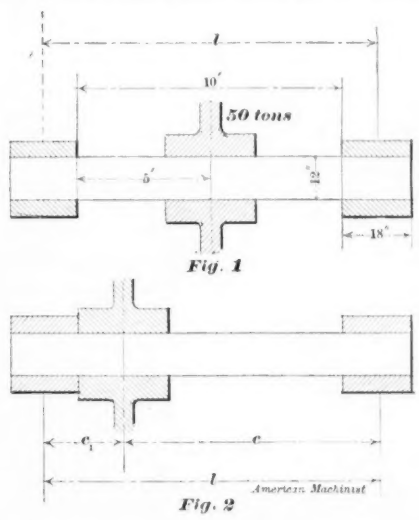

Fig. 1 *Fig. 2*

these conditions we have a beam loaded in the center and supported at each end. For finding the deflection of such a shaft we have the following formula:

$$\frac{1}{48} \times \frac{W \times l^3 \times 64}{E \times d^4 \times 3.1416} = D, \quad (1)$$

in which W = load in tons, l = length of shaft in inches measured from center to center of bearings, d = diameter of shaft in inches, E = coefficient of elasticity, and D = deflection in inches. For wrought-iron the value of E may be taken at 12,500 tons per square inch, and for steel 15,000 tons per square inch. Substituting for the symbols their values, we have

$$\frac{1}{48} \times \frac{50 \times 138^3 \times 64}{12{,}500 \times 12^4 \times 3.1416} = D = 0.21 \text{ in.}$$

This is the deflection for a wrought-iron shaft, provided the elastic limit is not reached. For steel shafts the same formula is used, with this difference: Instead of using 12,500 tons for the value of E, use 15,000 tons. The deflection as found above is, however, too great for a fly-wheel shaft, and indicates that the load must be reduced, or the diameter of the shaft increased. For computing the deflection of the shaft when the fly-wheel is placed close to one of the bearings, we again assume that the center of the hub only bears on the shaft, or, in other words, we assume that the whole weight of the fly-wheel is concentrated at one point in the center of the hub. For a case of this kind we have the following formula:

$$\frac{64 \times W \times c^3 \times c_1^3}{9.42 \times E \times d^4 \times l} = D, \quad (2)$$

in which c is the longer distance in inches from the center of one bearing to the center of fly-wheel, and c_1 the shorter distance in inches from the center of the other bearing to center of fly-wheel as shown in Fig. 2, the other symbols denote the same quantities as before. Substituting in formula (2) for the symbols their values we have

$$\frac{64 \times 50 \times 114^3 \times 24^3}{9.42 \times 12{,}500 \times 12^4 \times 138} = D = 0.07 \text{ in.}$$

2. Is there a rule for finding the steam pressure under a given amount of compression? Say we have a cylinder 12 inches diameter, the piston is at 6 inches from the end of the stroke, and in this position the steam pressure is 10 pounds per gauge, now what will be the pressure when the piston is at 2 inches from the end of the stroke? How do you compute this pressure under the assumption that there are no ports? *A.*—According to Mariotte's law the volume multiplied by the absolute steam pressure is a constant quantity. Since the cylinder is of uniform diameter throughout we may simplify the above a little, and say that the length of the space multiplied by the absolute steam pressure is a constant quantity. The absolute steam pressure in your case is 10 + 14.7 = 24.7 pounds, and the steam at this pressure being confined in a space 6 inches long, we have 24.7 × 6 = 148.2 for the constant quantity; hence the absolute pressure when the piston is at 2 inches from the end will be $\frac{148.2}{2}$ = 74.1 pounds, or 74.1 − 14.7 = 59.4 pounds per gauge.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

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New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc; machinery name plates in brass and aluminum.

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"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Recent Progress in the Manufacture of Steel Castings.*

BY H. L. GANTT, ELIZABETH, N. J.

Before beginning the main subject to be treated in this paper, it would seem not inappropriate to point out a few of the steps by which the art of casting steel has arrived at its present advanced state. I must not be misunderstood to mean by this, that the process is not susceptible of improvement over what we have already arrived at; but when we remember what the ordinary steel casting was a few years ago—a rough chunk composed of about equal parts of steel and holes—and note that to-day a steel casting is subjected to a more rigid inspection for cracks and holes than an iron casting, while the general appearance is required to be nearly as good, we are forced to admit that a great advance has been made.

* Presented at the New York meeting (December, 1893) of the American Society of Mechanical Engineers.

When I spoke of the condition of the art a few years ago, probably but few realized how very few years were really meant. The first soft steel castings, such as are used for gun carriages, that were made in this country, and which were subjected to a ballistic test, were made in 1886 and 1887, by the Midvale Steel Company, who were the pioneers in this work. The ballistic test was considered severe at that time; but to-day the ordinary soft castings made by almost any one of a dozen of the best steel casting companies would pass it successfully.

Though it was about 1886 or 1887 before any large increase took place in the use of steel castings, they had been successfully made in this country at least as early as 1867.* In July of that year, the William Butcher Steel Works, now the Midvale Steel Works, cast some crossing frogs for the Philadelphia & Reading Railroad of crucible steel. The molds were made of ground fire-brick, black lead crucible pots ground fine, and fire clay, and washed with a black-lead wash. The surface of these castings was very smooth, and the metal, which was practically tool steel, was so well adapted for the purpose that some of the castings made in those early days are said to be still in use.

This was before the use of silicon for solidifying steel was known, and the castings were very much honeycombed in all parts except the wearing surface of the frogs, which was "cast down." The possibility of getting one face of a casting approximately solid admitted of the use of steel also for hammer dies, although their general sponginess was a great obstacle to their extensive adoption.

On April 28, 1876, two small hammer dies were made of open hearth steel at the same place, and on May 29th a hammer head weighing 2,535 pounds was made. As long as castings were small, the molding mixture of ground brick, ground pots, and fire clay was satisfactory; but on large castings made with that facing, the surface was very imperfect, and the sand adhered to it with great tenacity. But little improvement in the method of molding was made for some time, and while the quality of the steel was gradually improved, the appearance of the castings was decidedly against them, and but little progress was made in their introduction.

The next step taken by the Midvale Steel Company was to leave the ground pots out of the molding mixture, and to wash the mold with finely ground clay fire-brick. This was a great step in advance, especially in heavy castings, and a marked improvement took place in their general appearance; but the mixture still clung so strongly to the casting, that only comparatively simple shapes could be made with certainty. A mold made of such a mixture became almost as hard as fire-brick when dried, and offered so much resistance to the proper shrinking of castings that, when at all complicated in shape, they had so great a tendency to crack that their successful manufacture was almost impossible. The next step was to use a mixture of silica sand and flour. In small castings this gave pretty good results, as such a facing cleaned off the castings very readily, leaving a smooth surface much superior in appearance to that left by the ground brick. The great difficulty in the way of the extended use of such a facing was the tendency of the flour to burn in drying, leaving the sand without a proper bond, and often the burnt mold was so friable as to be entirely useless. In the case of large castings it was almost impossible to dry thoroughly the whole mold without burning that portion nearest the fire, and for such work flour was necessarily abandoned.

By this time the use of silicon for solidifying castings was coming into general use, and the only obstacle in the way of making good steel castings was the want of a suitable molding sand. This was ultimately found in a mixture, the principal constituents of which were silica sand and molasses thoroughly ground together.

The improvement in the appearance of castings caused by the use of a sand that left a clean, smooth skin was the cause of their rapid adoption; and the year 1887, when the Midvale Steel Company made the first gun carriage castings of steel, is approximately the date at which their rapid extension began.

At this time the necessity for hot metal did not seem to be understood, and castings frequently contained "blow-holes," when it seemed that all the conditions for making them perfect had been complied with. It was noted before a great while that small castings contained more holes than large ones, and that those poured last on a heat were worse than those poured first. The conclusions that hot metal was needed to make solid castings, and that smaller castings needed hotter metal than large ones, were soon deduced and amply verified. Apart from these considerations, the superior appearance of castings made from hot metal was sufficient to cause all steel castings makers to work in that direction. The difficulties in the way of getting uniformly hot metal are hard to overcome in an open hearth furnace. The delay caused by a slow or difficult tap of the furnace, which is always liable to occur, is fatal to the productions of the best castings. Besides what has already been mentioned "cold metal" in the ladle is to-day the cause of more complaints by purchasers, and expense to the manufacturer, than anything else in connection with the manufacture of steel castings. I will enumerate a few of the troubles that may be traced directly to this cause What is known as a "bad shut off," or a leaky stopper, is usually caused by a small amount of metal chilling in the nozzle, and preventing the stopper from going to its place. In cases where the dribble is slight the worst effect is that a small amount of metal runs into the mold while the ladle is being gotten over the runner. This metal is apt to chill, and make a bad looking spot on the casting, or, in the case of small castings, block up the runner entirely, and cause the loss of the mold. When the leak is very bad it not infrequently happens, especially when the heat is a large one, composed principally of small castings, that the flasks are covered by the molten steel, and so strongly fastened together that it is almost impossible to separate them from the steel without considerable loss by breakage. Again, by a careful study of the subject, I feel that I have been able to lay to the door of "cold metal" one of the most fertile sources of complaint which steel founders have met with, namely, lack of homogeneity, which includes both "hard spots" and "loose" places. I use the term "loose" rather than "spongy" for the reason that I do not so much mean a cluster of holes as a spot where the metal simply seems less dense. Such places, without any visible continuous hole, or even without anything that would indicate the existence of such a hole, allow leaks in hydraulic cylinders, and cause the failure of a test bar.

When we consider more in detail the process of making open hearth steel castings, we see why these defects are more apt to occur in cold than hot metal. While the metal is being tapped from the furnace, the silico-spiegel necessary to prevent "blow-holes" is generally thrown into the ladle, usually in the solid, though heated, state. If the metal is very hot, and consequently thoroughly fluid, the silico-spiegel is dissolved at once, and uniformly disseminated through the mass. If, however, the metal should not be so hot, it is easily seen that the silico-spiegel may not become at all thoroughly diffused, and the slightly viscous metal in the ladle may be the reverse of homogeneous, in which case the resulting castings may be very far from what is hoped for. It is now the practice, in the best foundries, to melt the silico-spiegel, and these defects in their worst form are thus practically eliminated.

Why hard spots should appear in cold metal is readily seen, for lumps of partially melted silico-spiegel would certainly form the nuclei for such spots; but why the "loose" places should occur is not quite so apparent. It may be noted that the loose places appear to a more marked extent in large masses than in small ones, and the most reasonable explanation seems to be that the silico spiegel, which is but imperfectly melted when the metal is poured, finally melts thoroughly after the metal is in the mold, which can only occur in very heavy castings, forming a spot higher in carbon, manganese and silicon than the metal surrounding it. Such a spot would have a lower melting temperature than the adjacent metal, and would remain partially fluid after the other metal was set. The result of such a condition would be to drain away a portion of the fluid metal to feed the shrinkage in the metal solidifying about it, leaving a more or less spongy spot.

That shrinkage holes and cracks do still occur in steel castings is well known, but the success that founders have had in casting complicated shapes within the last year or two has been surprising. The fact that a steel casting *must* cool at the bottom first, and then gradually upward in the mold, is being learned by designers, and shrinkage holes are becoming less frequent, for the founder at once fixes on the heaviest portion for his sink head, which is usually about 20 per cent. of the total weight of the casting, and which must remain fluid until the whole of the casting proper is solid.

By a strict observance of the rule that a steel casting should, as far as possible, be of uniform thickness throughout, it has been possible to make, within the past few years, castings 20 feet long by 10 feet wide, which would have been considered impossible a few years ago. To one unfamiliar with the details of the process of making steel castings, the statement that to day we can get large steel castings that are perfectly satisfactory, while it is almost impossible to get good small ones, would seem very strange. It is, however, a fact, and the explanation is simple. Most steel castings are made by the open hearth process, and the furnace usually melts from 5 to 20 tons. To pour even five tons of steel into castings averaging 100 pounds in weight would, as a rule, take so long, that those poured last would be of inferior quality on account of the cooling of the metal. As a rule, a large portion of the heat is poured into a comparatively few large castings, and the remainder put into the smaller ones. If the metal is very hot to start with, this may give fair results, but in all cases the least desirable metal is put into the small castings.

This difficulty seems almost insurmountable by the open hearth process, but is readily overcome by a small Bessemer converter, from which we can get two or three tons of metal as hot as we may wish it. Add to this the fact that we can get from the converter that quantity of metal of any composition we may desire, every half hour throughout the day, and we realize the advantage of the Bessemer process for making small and medium weight castings. The manufacturers of electric motors who have been buying their castings from open hearth foundries have apparently not realized what the Bessemer foundry has in store for them. It seems hard to believe that perfectly solid steel castings can be made of the following composition with regularity: Carbon, 12 per cent.; manganese, 30 per cent.; silicon, 30 per cent.; but it is a fact. It may be noted, however, that this steel, while very well adapted to electrical purposes, is of but little value for any miscellaneous castings, except very small ones, on account of the tendency it shows to crack during the process of solidifying when cast in shapes at all complicated.

The fact that we can make a number of different kinds of steel each day if we use a converter, and but two or three heats at most in 24 hours if we use an open hearth furnace, gives a great advantage to the founder using the converter, especially if he is making all kinds of steel castings, enabling him, as a rule, to make far more prompt deliveries than is possible for the open hearth founder doing the same variety of work.

Among the other advances made in casting steel may be mentioned one for making a casting having one or more faces of a steel much harder than the body of the casting. The process consists in lining such faces of the mold as will be adjacent to the parts of the casting it is desired to harden with a metallic alloy in a crushed or powdered state, capable of being melted and absorbed by the molten steel in contact with it, and of such a nature as to impart to the steel a hard face or a face of such a composition as may be readily hardened. If it is desired that the casting shall have a permanently hard face and be used for stamp shoes, crusher jaws, hammer dies, etc., ferro-manganese gives the best results. If it is desired to do machine work on the face, and make it extremely hard afterwards, ferro-chrome is most suitable. The fact that it is possible to produce a soft steel casting, having a face that can be hardened without causing the remainder of the casting to become brittle, will undoubtedly make it possible to use steel castings in place of chilled iron in many places with great advantage.

*This historical note was furnished some time ago to Mr. Edwin H. Cramp, to go into a paper he purposed to write on the subject of steel castings, but it has seemed to me to be of sufficient interest to publish it here also. If any member has any additional information on this subject, I should be glad if he would add it in the discussion.

A Visit to a French Flag Ship.

BY WILLIAM H. HARRISON.

Having been interested all my life in all things which float upon the water, especially those things that are moved by steam power, I took advantage of the liberty which was granted by the French Admiral to all well-disposed persons, and paid several visits to his ship when she was in Boston Harbor during the past summer. This ship was called after their fanciful poetic manner of naming things, the "Niobe"—the goddess of tears, if I remember aright—and some might infer from her name that she is a particularly wet vessel, but an inspection of the lofty ship rig and high sides showed that, with reasonable care, she can live in any sea and sail round the world on her own bottom.

There is a great deal to be said in favor of these old style ships in comparison with the modern ones, that can only carry supplies enough to get them into trouble, leaving nothing for the homeward run. She is "composite built," plank upon iron frames, a compromise between the old style of construction and the new, so as to give the old carpenters employment. Grand men were those old carpenters in their day!

Going off in a 12 oared boat, I had a chance to observe something of the rowing of French sailors, which to me seemed very forced and unnatural, a very quick "recover," which necessitates a lengthened pause before dipping; but as this is the stroke by the use of which Harvard University usually gets beaten each year in their races, it may have the advantage of science on its side. The unique thing about the rowing in the French boat is the fact that on the "recover" or swing forward of the oar blades, they feather them the wrong way, the loom of the oar being rolled over from the man, and the forward edge of the blade inclined toward the water, the theory being that a longer reach in the water is thus obtained. The practice, however, must result in the catching of a vast number of crabs when there is any sea.

Another trip I made in a "*Batteau a vapeur metallique*," this being a steel steam launch lap streaked, and with large rivet heads sticking out all over the outside. The original model had been sufficiently hideous, and being built upon molds, the strained plates had caused her to change her shape after their removal, leaving her very distinctly lop-sided.

The engine was a reduced copy of that of a man of war, two horizontal cylinders on

one side of the crank shaft and the crossheads the other side, with return connecting rods; very noisy, of course, as they do not have men small enough to get down in the bottom of the boat and make the proper adjustments.

The advantage of this style of engine for a launch is supposed to be keeping the weights low; there is also the further gain that there is no danger of overheating the cylinders when there is water in the boat.

The boiler was one of those mixtures of gas pipe, sheet-iron, rust, leaks, asbestos paper and ashes, which are so familiar to those who journey in steam yachts and launches, as to require no further description. The advantage claimed for this style of steam generator in comparison with a shell boiler is that they can (and do) split a tube any day without doing serious damage—except to the temper of the owner—and the repair jobs make fine business for the gas pipers.

To say that she was extremely dirty is not putting any blame upon the men in charge; it is simply an impossibility to preserve cleanliness in any boat run in a half crippled condition. There are so many tools to be used with oily hands, and so much oil to be thrown at random on the moving parts, owing to the fact that the necessity of oiling has received but little attention from the designer, that it is no wonder that the coal dust gets mingled with it, and is soon applied as a dingy pigment to all parts of the boat.

Coming on board I noticed the mottoes or legends.

On the break of the forecastle were the words *Valem, Discipline*, and on the upper cabin, *Fidelite Patrie;* this latter would not do for our ships, as it might cause confusion in the minds of the ship's company as to what *patrie* their *fidelite* was due.

I noticed, however, two wicked looking multiple-firing guns, just forward of the officers' cabins, bolted fast, and for no other apparent use than to clear the gun deck as a "court of last resort," for cases of that kind.

The legend idea they seem to carry on all through, thus on the breech mechanisms of the guns are words showing which way to turn the handles, thus requiring the operator to be a reader, a very doubtful accomplishment. In the engine-room it is the same way, the names of every valve and lever, and the way to turn them stamped on, but this is neither good seamanship, nor good engineering; it would be considered an absurd thing on deck if every halliard and sheet and down haul were to have a tag showing its name and uses.

A seaman if in doubt about the lead of a piece of running rigging, sways gently upon it looking aloft at the same time, to see the movement transmitted to the sail or spar and the practical knowledge gained in this and other ways enables him to handle with confidence the lines, from a crowded pin-rail by feeling in the darkest night.

In an engine-room it is much the same, the uses of pipes are made known by tracing them out, and observing their lead, and a knowledge of valves and levers obtained by actually working them, and observing the effect. In engine work where there is so much hidden from sight, the knowledge of the hidden things can only be obtained by overhauling, as in making repairs and adjustments, and although the drawings may be useful as showing what you are to look for, there is always considerable chance for going astray, by too much dependence upon them.

But to return to my story; I observed many carpenter's mates working on deck on various kinds of work, boat repairs, spars, joinery, etc., and it gave me a pain to notice the miserable and rude tools with which they were condemned to labor; yet they were merry enough knowing no better, and being an extremely light hearted race. I think their poor tools may be to some extent due to the streaky, shaky, and knotty woods which they have to work. With poor tools and poor stock, there is, of course, a poor product, and so indeed I found it on this ship; all her wood-work was in no way superior to what may be found in any down-east brick or lumber schooner.

The *Chef des Charpentiers* carried in his hand a specimen of the much-lauded French yard stick or *metre* 39.37 inches long, and as I had never seen one before in practical service I was curious to notice how he used it. All I saw him do was to use it as a staff or cane as he walked about the deck, or as a pointer in directing the work. Now canes and pointers were in use, I believe, many years before those ingenious French mathematicians struck upon the elegant method of establishing as their length the forty-millionth part of the earth's circumference measured over the poles on the longitude of Paris, so that in this regard I can see no improvement.

For actual and practical measurement his men marked upon battens in the good old way, not troubling themselves about *centimetres* or *millimetres*, but fitting piece to piece.

The carpenter having disencumbered himself of his *metre* (and probably soon after forgetting where he laid it) I had an opportunity to examine and find out why it is so little used for real measuring. It is divided into 100 centimeters with a long mark for every 10, *but nothing finer*, for by their decimal system the *millimetre* equal to $\frac{1}{25}$ of an inch is too fine for ordinary eyes; yet it is considered by our educational cranks a good thing to try the eyes of school children. I have before me as I write one of the short pieces of a *metre*, used as an educational exhibit in our schools. As the thing stands to-day it is merely adding one more system of measurement to the already numerous systems which we have to learn with the disadvantage that the French system is not readily converted to any of the English systems, all of which have their uses in the different trades. My 24-inch rule measured about 61 centimeters, folds conveveniently in four equal parts to go in my pocket, is graduated in eighths and sixteenths, and cost 10 cents. No wonder then that the whole force gathered round me to admire this wonderful *Metre d'Amerique*.

Coming down into the engine room I noticed the *Indicateur Richard* (pronounced Reeshard), and I smiled to myself at the queer sound of our friend's name, and studied the application of the French system of measures and weights to steam pressure gauges. They are marked with large figures 1, 2, 3, 4, 5, 6 in atmospheres or *kilogrammes* per square *centimetre;* I do not know which as the average atmospheric pressure is 1.033 kilos, so the difference is not great.

There was also a graduation in tenths between the figures which would give readings equivalent to about 1½ pounds per square inch. The pressure carried is usually 5 0, same as 75 5 pounds per square inch. The vacuum gauge is marked like ours the same as the barometer, our 29 92 inches of mercury column having its equal in the 76 *centimetres* of the French, neither of them being a logical gauge for engine-rooms, as height or distance is not pressure. Our vacuum gauge has, however, the advantage that by dividing its reading by 2, the pounds vacuum per square inch, or pounds that the atmospheric pressure exceeds the pressure of the steam in the condenser may be obtained approximately. There be many among us who do not know of this use of the figure 2, and give their readings as straight pounds; when corrected they do not understand the lengthy explanation.

The smallness of their standard for piston areas a square *centimetre* = .155 square inches, and the largeness of the weight standard seems to me very inconvenient; thus a pressure of 100 pounds per square inch becomes 7.05 *kilogrammes* of 2.2 pounds each per square *centimetre;* the small fraction .05 must not be neglected, as it has a value equal to .75 pound per square inch. Of course, much depends upon getting used to it, but I can see no real reason why in this country we should need a change.

The engine was built in 1880; it has three horizontal cylinders of equal dimensions on the same side of the crank-shaft, each with two piston rods arranged diagonally, and reaching to the crossheads on the opposite side of the ship, with return connecting rods, being an adaptation of the well-known Maudslay design for war ships. The intention was to use moderately high steam, 75 pounds in boiler, and expand five or six times equally in each cylinder.

The cylinders I judged to be about 56 inches by 3 feet: they are steam-jacketed all over; they indicate 2,700 horse-power at 60 revolutions, with a possible 3,000 horse-power at higher speeds.

In the fire room there were eight cylindrical boilers, with two furnaces each and return tubes. The furnaces had circumferential V-shaped ribs, rolled on about 6 inches apart, and they were in splendid condition.

Looking under the deck and over the cylinders, I observed the gleam of something which reminded me of dash pots, and sure enough there they were, 12 of them, and my mind was carried back to the time celebrated in song and story, when we, too, had our dash-pots to contend with. The story is too long, but this is a sample of the song:

"One pot the more, one pot the less
Would make no difference in the view;
For all that's best of loveliness,
And all that's best of science too,
Are garnered up, mankind to bless,
In dash pots of the brazen hue."

There is a separate steam valve and exhaust valve, at each end of each cylinder, double beat or Cornish, about 20 inches diameter, with two-inch lift. They are operated by cams upon two long shafts laid parallel to the crank-shaft over the centers of the valves. Their rotations coincide with those of the crank shaft. For holding the valves down, so as to ride on the cams until seated, a spring is necessary; hence these dash-pots; which are open-topped, and act by the vacuum formed beneath their plungers when lifted by the action of the cam. The cams are very long on the shafts, and are shifted endways about 24 inches, to change the cut off and for reversing, this being effected by a third shaft, with arms acting as a piston rod in a steam cylinder, and located between the two cam shafts.

The objection to this sort of valve gearing for screw engines is the impossibility of making it work without shock. Thus the steam valve when cutting off sufficiently short, to get the value of the expansion, is required to open and close in the one-eighth part of a second, or while the cam is moving through one-eighth part of its revolution. The designer of this gear made a pretty good try to get what he was after, but I should never expect to see it repeated.

There are many other places in this engine-room where the lack of practical knowledge seems to be shown, notably in the shaft alley. Of course we know that shafts break now and then, and this gives a chance for unprofitable invention in flexible shafts, so here we find two complete spade handle or Hookes' joints, a flexible coupling, and a pivoted thrust bearing, each with its own particular noise and liability to derangement, together with great increase of weight and room occupied, in the crowded limits.

It seems to me if this engine-room is a fair example, that the French Navy 13 years ago was experimenting along about where we were 33 years ago.

There is a curious defect in the French names for things about an engine, which shows that the man who adapted them from the English did not fully understand the uses of the things he was naming. "Donkey pump," which is really a short shop name with a comic twist to it, for "spare" or "auxiliary pump," becomes through a literal translation, "*Pompe de petit cheval*," "Pump of the little horse."

"Donkey boiler," which means a spare or small boiler, becomes "*Chaudière de petit cheval*," Boiler of the little horse."

"Feed pump," which is really a pump for supplying the boiler with water, becomes "*Pompe d'Alimentaire*," which I have seen in print, re-translated, as the "Pump of nourishment."

Of course, our names were wrong at the start, but that is no reason why a nation which prides itself on its science and its metric system should preserve such crudities.

The "boiler of the little horse," was *hors du combat*, in consequence of having been "nourished" with sea water when engaged in supplying steam for the fresh water condensers for ship's use. This boiler is a *generateur tubulaire*, lately put on board for this very purpose of evaporating fresh water from sea water, and they expressed themselves as much surprised that the tubes should become plugged with salt and scale when the circulation was so rapid.

The broadside guns are 13 centimeter (5⅛ inches) bore, with the screw breech plug and packing, originally an American invention, and now used in all our guns. The rifling is the gaining twist, long ago discarded by our rifle experts and artillerists.

The galley or *cuisine* was not so attractive as might be expected on a French ship. On shore they have their fire-brick stoves and charcoal, but on the ship they were of iron of vast size, very hot and fired with their smoky coal, and located on the berth deck; the *cusiniers* looked very smutty and overdone.

In concluding my story, I would remark that I saw nothing on board this ship or the others which I visited in which we are not far superior, except their politeness and their magnificent band; during visiting hours the ship was crowded in every part with all sorts of people—bumboat women, militia officers in full uniform, policemen, boatmen, women, young and old; citizens in faded pot hats, and Chinamen in pig tails—all these mingled with the ship's officers and company, and the band withal giving me the feeling that I was witnessing all the Gilbert and Sullivan operas in one lump; yet with all this inconvenience I saw no one who showed it in his face or language.

Feeds and Other Matters Connected With Milling Machines.

BY J. A. MCGREGOR.

In your issue of November 30th are some interesting articles on milling machine feeds. J. M. L. says, "Have experienced very little trouble from backlash." Now, my experience has certainly led me to believe that cutters cannot be run with the work unless arrangements are made for automatically taking care of the backlash. Perhaps, however, milling can be done on a small scale without some arrangement for this purpose. I have watched the operation of some very large milling machines, which were milling the faces of motor gears. These faces were those which bolt together upon a shaft, the gears being in two parts, and were 4½" wide, two of these being milled at a time, making a cut equivalent to 9" in width. The foreman declared that he spoiled more cutters than the whole thing was worth. There were no arrangements on this machine to take care of backlash, and hence all the trouble and loss of time. I noticed in a book on milling, which is on my desk, that the author says, "As soon as this hard skin is once broken through, the teeth of the cutter in commencing the cut impinge the softer metal, and when the hard scale is reached at the end of the chip, it is in a manner pried or broken off, and thus the cutting edges of the teeth escape the injurious effect of contact with the hard surface." I am quite sure when the above was first published that we all agreed with it. I simply quote it to show that things we once thought were true are true no longer.

Inserted teeth milling cutters are fast coming into use, the body of these being sometimes made of cast-iron, and for some kinds of work the Mushet or self hardening steel is used for the teeth. Some years ago we made cutters with too many teeth in them. Much better results are obtained from cutters with relatively coarse teeth, say about ¾" circular pitch. The number of teeth in a cutter vary to suit the differ-

ent kinds of work to be milled, and the speed of cutters should vary from 33 to 70 feet per minute for cast-iron.

To those who want to stay in the old ruts and use weak milling machines, I would recommend that they continue to use fine tooth cutters. In using these fine tooth cutters there is no danger of "the platen being picked up and dropped hundreds of times," neither is there any danger of the operator or owner getting rich very fast. I once called on one of the leading bicycle manufacturers (in the interest of the Brown & Sharpe Mfg. Co.,) and found them using about 100 milling machines, and also learned from the superintendent that they were about to give up making the old style of fine tooth cutters, and for irregular forms they were going to try the patent or formed cutters. After securing their order for about $500 worth of cutters, I advised them that I was very much in doubt about their weak milling machines being able to carry the modern cutters. After they received the cutters, I again called and found the new cutters on the shelf and the old ones in use again. After some scolding, etc., we got a new style cutter at work. The man in charge said, "Don't you see how that machine jumps?" and finally the belt came off. In a second trial I suggested using oil more freely. Pat, or some other fellow was called and asked to stand at the back side of the machine with the ordinary oil can and pump for all he was worth, but again the belt came off and the foreman said, "There is no use, I tried those formed cutters years ago on gun work, and they were no good." I turned to the superintendent, and said to him, "You are not in it; we cannot use these cutters here." After a short conversation and some correspondence, I secured their order for new milling machines with oil pumps, and learned afterwards that the new cutter and new machine were doing 50 per cent. more work than had been possible with the old machines.

This is only one example out of hundreds of similar ones I have met. We therefore hope the time is near when those that are struggling with what once was considered all right will try again.

Joseph Wainwright.

In the death of Joseph Wainwright, of the firm of Hill, Clarke & Co., of Boston and Chicago, the trade meets with a serious loss. Brought up in the shop, he carried to his business a practical knowledge of machine tools, which, added to first-class business ability, good knowledge of men, general tact, and power of organization, pushed him rapidly to the front. Upright and straightforward in his dealings, his fine sense of honor, gained him the esteem of those with whom he was brought in contact in a business way, while it endeared him to those who had close business relations with him. His death is a loss to the community. He died at his home at Medford, Mass., on the 13th inst., of Bright's disease.

Abolishing the Belt.

A new Belgian factory, according to a correspondent in that country, uses electricity to transmit its power instead of belting, and we think that a brief description of this device may prove of interest to our readers. The dynamo is 600 horse-power, and forms the fly-wheel of the compound Corliss engine. The shop is supplied with 16 motors, and among them ten 16 horse-power, one 21 horse-power, and one 37 horse-power motors. Their average efficiency is 87.2 per cent. On some of these motors the load is very variable, and several are exposed to dust and dirt, so that with 90 per cent. efficiency of the dynamos, 98 per cent. of the conductors, 87 per cent. of the motors, the net result is 76.6 per cent. power delivered. As the lost work in belt-driving is practically a constant quantity for all loads, or, at least, is usually considered to be, the power required to turn the shafting, pulleys, etc., when no work is being done on the machines, it follows that taking 79.4 per cent. as the final output in two cases, one of electrical and the other of mechanical transmission, we find that at a load of 20 per cent. the electrical system would still give 47.2 per cent. useful effect, and the mechanical nothing at all. From careful experiments which have been made in actual practice, we learn from this same source, it has been clearly proved that to drive all the idle machines requires more power than to drive the shops in ordinary course of work; whereas, 11 electrical horse-power is required when driving all the idle tools, only about seven electrical horse-power is needed in ordinary work, of which four electrical horse-power is used to drive the shafts, belts, etc., alone; this clearly shows how small a part of the power produced by the engine is actually used in useful work at the tools. Such satisfactory results of the application of electricity to factory driving must attract attention, and will doubtless lead to great changes in transmission. Whether in the case of large machine tools it would not be better to discard shafting and belts altogether, and supply a special motor to each tool, is a question which must be settled for each individual case which may arise; the current would be switched on or off just as easily as the belt is now thrown from the loose to the fast pulley, and *vice versa*.—*Machinery*.

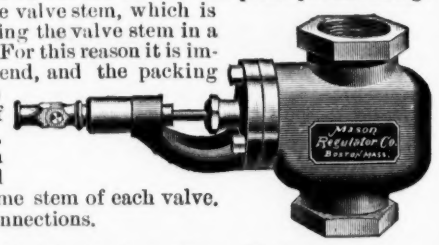
Locomotive Engineering publishes a little story which has plenty of counterparts. It is all about a fussy railroad superintendent who bothered every one else because he thought nothing could be done right unless he personally superintended the doing of it. By-and-by he was taken sick and was wonderfully astonished to find on his recovery that everything had gone on as usual—no collisions or accidents of any kind, equipment in good condition, and stock of the road had advanced in price.

Thus far the story of our contemporary is straight enough; with a little change in names and conditions it is happening every day. But the finale is altogether improbable. It is to the effect that the experience cured him. It does not work that way and this impossible finale discredits the whole story. The moral is there, however, just the same.

The next in the list of the mechanical series of books by the Mason Regulator Co., Boston, Mass., is entitled "Electricity for Engineers." It will be issued January 1st, and is said to be written in plain language, with no formulas. It will contain in full the rules of the International Underwriters' Union, for electrical installations.

THE MASON BALANCED VALVE

Is a double piston or seated balanced valve, for which we have found a ready sale in the many cases where such valves are used. The principal advantage of our valve is in the guide for the valve stem, which is cast on the bonnet, thereby keeping the valve stem in a direct line with the stuffing box. For this reason it is impossible for the valve stem to bend, and the packing seldom has to be renewed. The sizes up to two inch are made of the best steam metal; above that, of cast iron, lined with steam metal. A knuckle-joint tapped for three-eighths rod is on the same stem of each valve. This saves expense in making connections.



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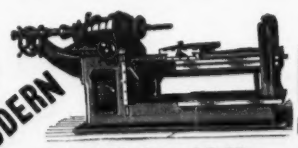

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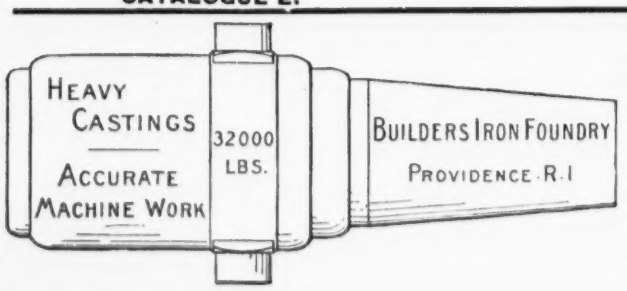

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MANUFACTURES.

The Derby Cotton-mill, Shelton, Conn., has started on full time.

The Belknap Motor Company, of Portland, Me., is to make addition.

A part of the Troy (N. Y.) Steel and Iron Company's plant has been started.

The Braddock Wire Works, at Rankin, Pa., is in full operation in every department.

Zug & Co's. plant, Pittsburg which had been off work for a week, has resumed.

The New Haven (Conn.) Rolling Mill has started up with a full force, after an idle summer.

H. Sherk & Son's cotton-mills at Lancaster, Pa., which have been idle for some months have been started.

The Winkley Manufacturing Company has been formed at Kansas City, Mo., to manufacture machinery.

At Concord, N. H., the owners of the new mill announce that they have orders enough ahead to last them all winter.

The Auburn church furniture factory, at Auburn, Ind., was recently destroyed by fire supposed to have been set by tramps.

Latest accounts from the Penberthy Injector Company, Detroit, Mich., are to the effect that hey have work enough for full time all winter.

The puddling department (employing about eighty men) of Jones & Laughlin, Pittsburgh, Pa., has been put on full double time for the first time since spring.

The Maryland Steel Company, of Sparrow's Point, Md., is constructing eight canal lock gates for the Government. They are to be used on the Columbia River, Oregon, and each gate will be 90 feet wide.

The Electric Light Company, at Ellsworth, Me., is to place in the water-power station a large 200 horse-power engine to be used as a reserve to that water-power.

The Champion Card and Paper Company, of Pepperell, Mass., has started up with a double force of operatives, and the work will be kept up day and night.

The Torrance Iron Company has been reorganized at Troy, N. Y. G. L. French is president; C. A. McLeod, vice-president; N. H. Squires, secretary and treasurer.

The Baltimore & Ohio railroad shops at Garret, Ind., which have been almost entirely shut down for the past four months, have started up with a full force of 550 men.

Wallace, Banfield & Co., Limited, operating the Irondale (O.) rolling-mills, are operating their entire plant to its utmost capacity, three turns of eight hours each.

The Peterborough (N. Y.) Manufacturing Company has started its works with a large amount of orders to fill, and has made an increase in the number of operatives.

The J. D. Smith Foundry Supply Company, Cincinnati, O., issue a catalogue of Monks molders' solid steel tools, which is fully illustrated and contains prices of tools.

The works of Pedrick & Ayer, Philadelphia, Pa., manufacturers of machine tools, which firm recently made an assignment for the benefit of their creditors, are now running 10¼ hours per day.

The Wardwell Sewing Machine Company, Woonsocket, R. I., general machine manufacturers, which has been employing a very small force of employes for four months past, has increased its force.

The annual meeting of the stockholders of the Norristown Steel Company, of Norristown, Pa., which went into the hands of receivers, has taken place. The receivers presented an exhaustive report, showing the affairs of the company to be in a prosperous condition.

The National Water Tube Boiler Company, of New Brunswick, N. J., have sold their plant of 1,500 horse-power boilers which they had at the World's Columbian Exposition, to the Ohio Steel Company, Youngstown, O.

The plans of the reorganization of the West Superior (Wis.) Iron and Steel Company, are said to call for an expenditure of $1,500,000. The proposed additions include an open-hearth furnace, blast furnace and coke ovens.

The 18-inch train at the Albany Iron Works, Troy, N. Y., has been put in operation. The Belgian and 14-inch trains are also running, giving employment to more men than have been on duty at the big plant for many months.

The Duquesne Tube Works has started several lap weld furnaces in its plant at Duquesne, Pa., giving employment to about 150 men. This firm has quite a number of orders on hand for boiler tubes, of which it makes a specialty.

The citizens of Belleville, Ill., have succeeded in raising $14,000 of the $15,000 necessary to start the works of the Belleville Steel Company. It is expected that the reorganization will be effected at the end of thirty days, and that the works will then be started.

The Worthington Condenser is the title of a catalogue issued by Henry R. Worthington, 86-88 Liberty street, New York, that we advise stationary and marine engineers to write for. It contains a large amount of information that will be useful to them in their business.

A correspondent at Angelica, N. Y., writes us: The heading factory of F. E. & J. M. Church is running eightee nhours a day, and are unable to supply the demand for their goods. There is a fine opening here for a hub factory, as the supply of suitable timber is large in immediate vicinity.

Manning, Maxwell & Moore, 111 Liberty street, New York, have issued a mammoth 1894 catalogue, some idea of which may be had from the statement that it contains 1103 imperial quarto pages, embellished with nearly 6,000 engravings. It is printed on a fine quality of paper, and elegantly bound.

A force of workmen from the Fisher Foundry and Machine Company's works, of Pittsburgh, is at work finishing repairs at the Wheeling Steel Works. The works are now in shape to be put in operation within a short time, but no start has been decided upon as yet, as there is no stock at the plant to work.

The Darnell Iron Company, of Muncie, Ind., resumed operations a few days ago under a new management, and on the co-operative plan. The new company is composed of the old employes of the mill and other Muncie citizens. T. F. Rose is president, Joseph Porter, formerly superintendent in the mill, secretary and treasurer.

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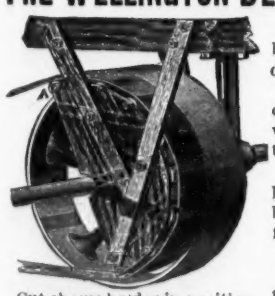
Engineers, Architects and Builders of

Iron and Steel Bridges and Buildings.

The above illustration, taken direct from a photograph, shows the interior of an Iron Foundry designed and built by us for The Farrel Foundry and Machine Co., at Ansonia, Conn. The building is 129 feet in width by 302 feet in length. The wings are 30 feet and 43 feet respectively, and the central portion is 56 feet in width. The central portion of the building is controlled by a hydraulic traveling crane, with a travel the full length of the building, and is also arranged with jib cranes for delivering material from the traveling crane to the cranes in the wing trusses.

SEND FOR OUR ILLUSTRATED CATALOGUE.

THE WELLINGTON BELT HOLDER.



Cut shows holder in position beside driving pulley.

Large or small belts shifted from driving pulley and held at rest, and easily slipped back when machine is to be started.
It dispenses with loose pulleys, saves belts, and is perfectly safe.
It is *cheap*.
Write for descriptive circular and price list to

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And mention American Machinist.

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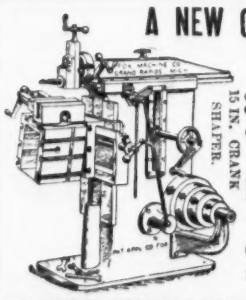

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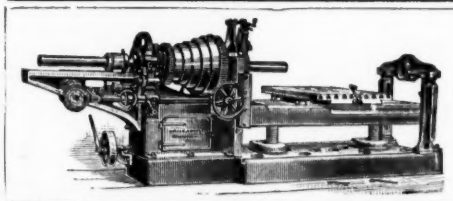
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set,		31.00

These Goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.
C. W. LeCOUNT, South Norwalk, Conn.



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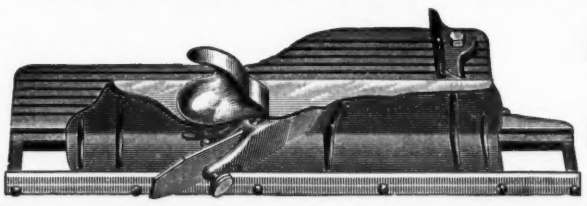

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for Saw Mills, etc. All or part of recent patent for sale at very low figure. Device is already a commercial success, address
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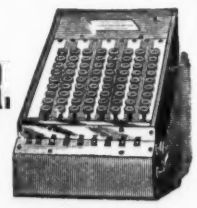

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FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
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"Star" Foot Lathe Swings 9x25 in.
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Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
Catalogue Free of all our Machinery.
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SIMPLE, COMPOUND, OR TRIPLE EXPANSION, HORIZONTAL OR VERTICAL
HIGHEST DUTY GUARANTEED.
COMPLETE DESCRIPTIVE PAMPHLETS ON APPLICATION.
HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO, ST. LOUIS, DENVER.

The big hardware factory of J. B. Sargent & Co., of New Haven, Conn., has begun working six days a week, eight hours a day. During the past two months the company, which employs over 2,000 persons, has been gradually increasing the number of hours of work, and now is running only one hour a day behind the usual winter schedule.

The Laughling Nail Mill, Martin's Ferry, O., which has been shut down for several weeks on account of inability to make shipments during the low water in the river resumed in full, giving employment to 800 men. All the mills of the Aetna Standard Company have resumed. About 600 men who have been idle for months were given employment.

The Reading Traction Company, of Reading, Pa., have placed the order for their new car house with the Berlin Iron Bridge Company, of East Berlin, Conn. The side walls will be of brick, the roof of iron. The building will be 85 feet in width and 180 feet in length. The width is divided into two parts of 42½ feet each, a row of columns supporting trusses at the center.

Agent Swinscoe of the Clinton (Mass.) Wire Cloth Company's mills says, in relation to the reported cut-down in wages, that the reduction was only the equalization of the wages with other wire mills in the country. He said that the lowest rate paid to-day in the local plant was higher than that paid in any other wire cloth mill in America.—*Commercial Bulletin.*

At Reading, Pa., there is nothing for discouragement in the industrial situation. The city is assured of two new industries, which are now under way and will be in operation before spring. The first is a galvanizing works, erected as an addition to the tube-mill of the Reading Iron Company, which will introduce a new branch of industry in connection with the plant of this establishment. Another new industry is the Millholland Tube Works, the machinery of which will shortly be introduced.

The Phosphor-Bronze Smelting Company, Limited, have removed their offices to 2200 Washington street, Philadelphia. In a notice giving location of new offices they say: Having erected a new foundry and smelting works at the above location, and greatly increased our facilities in every department for the manufacture of our original "Elephant Brand" phosphor-bronze ingots, castings, wire, sheet, rods, etc., we hope by concentration of management and direct shipment from our works, to secure for our customers prompt and careful attention to their orders.

Machinists' Supplies and Iron.

NEW YORK, December 16, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.00 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12.50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $12.00 to $13.00 for No. 2, and $11.25 to $12.00 for Gray Forge.

Antimony—The market is dull and unchanged. We quote L. X., 9.65c. to 9.70c.; Cookson's, 9 95c. to 10c.; Hallet's, 9c. to 9.05c., and U. S. French Star, 10c.

Lard Oil—Prime City is quoted at 72c. to 73c.

Copper—The market is quiet but steady. Lake Copper is quoted at 10.25c. to 10.30c. Casting Copper is held at 9½c. to 90.70c.

Lead—The indications of the market are towards improvement. Business is being done in a limited way at 3.20c. to 3.25c. There are speculative buyers at 3.20c.

Spelter—The market is dull. There are offerings at 3.75c. to 3 80c. for New York delivery.

Tin—The market is depressed, and buyers are indifferent. Bids are limited to 20.40c to 20.45c. for spot and near future.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Pos. by 1st-class pat'rnmkr & draftsman. P. A. C., care F. A. Knapp, 176 W. 95th st., N. Y.

Wanted—Situation as foreman or supt. elec. light station. Rubison, AMERICAN MACHINIST.

Situation Wanted—By steady, practical patternmaker and draftsman, age 33. P. D., AM. MACH.

Situation wanted by first-class patternmaker. Address BOX 141, AMERICAN MACHINIST.

Mach. draftsman open to permanent engagement, Jan. 1. Exp'd & good rec'd. W.H., AM. MACH.

A young man, tech. grad., with experience in erect'g & test'g auto.eng., erect'g locomotives, des. pos. as draftsman; good refs. BOX 140, AM. MACH.

An excellent opening for machinist foreman or "Tech." with shop experience, with small capital, in Phi'adelphia. BOX 142, AMERICAN MACHINIST.

Wanted—Pos. as supt. or chief engineer by man thoroughly exp'd in design and construction of machine and hyd. tools, power and hyd. cranes, gas producer mach'y, and plants and gen. mach'y. Expert in mfg. at minimum cost. J. W. B., AM. MACH.

Wanted—At a point in New Jersey a chief engineer of exp. to take charge of a large power plant of compound and triple expansion engs.; must be a prac. mech. thoroughly familiar with the theory and prac. of modern eng'g. Full refs. must be given, salary required, time when applicant would accept pos. must be stated. Barbette, AM. MACH.

Sup't Wanted—A large jobbing foundry having a capacity of 40 tons per day and running principally on architectural cast-iron work desires to secure the services of an experienced superintendent; must thoroughly understand the practice and economical production of heavy and light castings by the most modern foundry practice; must understand the mixing of iron and be competent to figure on work; to the right man, who can take general charge, we can offer extraordinary inducements, and will, as soon as ability is demonstrated, give interest in the business. Address Columns, care AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz. Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Wanted—Engine lathes—2d-hand in good order, 1 each, 24"x12', 28"x12', 32"x12'. Box 136, AM. MACH.

Calipers, Surface Gauges, etc. Catalogue free. Send for it. F. A. Welles, Milwaukee, Wis.

New 35 H. P. boiler, $155; engine, $75; screw-cutting lathes, 20" and 24", $135. 229, AM. MACH.

Agents—$5 Speed Gage, new, valuable, sells; shows constantly speed and slightest variations; Geo. T. McLauthlin & Co., 120 Fulton St., Boston.

Speed lathes, stiff, powerful, large hollow spindles, milling lathes, remarkably serviceable machs. W. H. Mansfield, 71 Court St., New Haven, Conn.

Wanted—To buy second-hand screw-cutting lathe to swing 20 inches over rest and turn 12 feet between centers: universal chuck, center rest, tools, etc. H H Childs, Rockford, Mich.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

We will pay 50 cents each for copies of the AMERICAN MACHINIST of December 4, 1886 issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Established in 1874.

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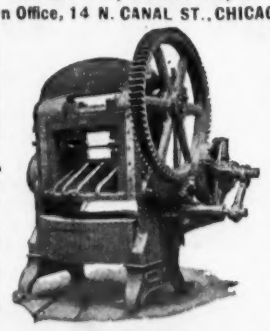

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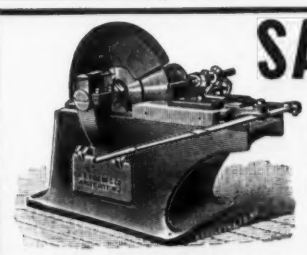

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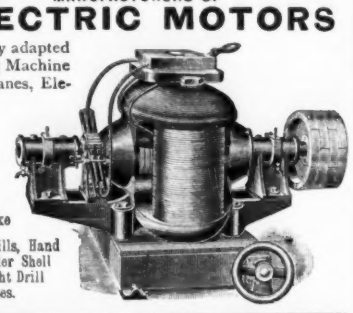

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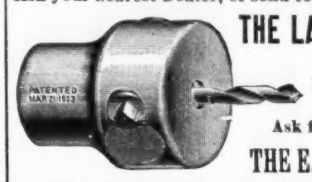

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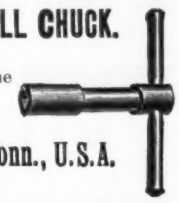

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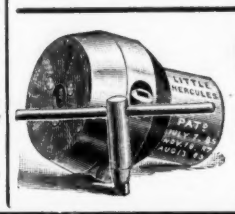

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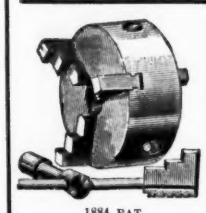

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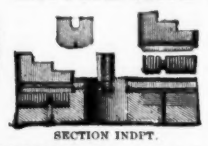

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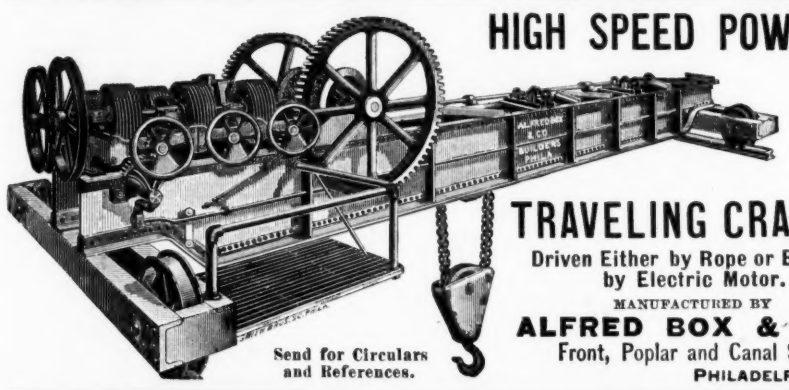

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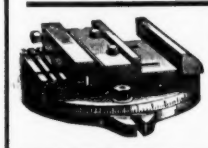

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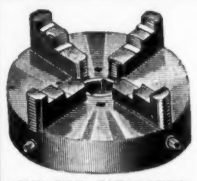

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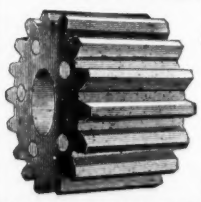

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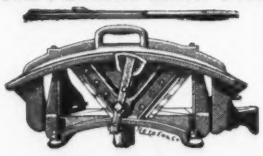

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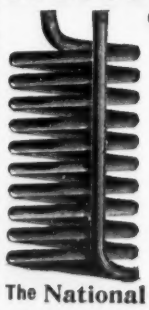

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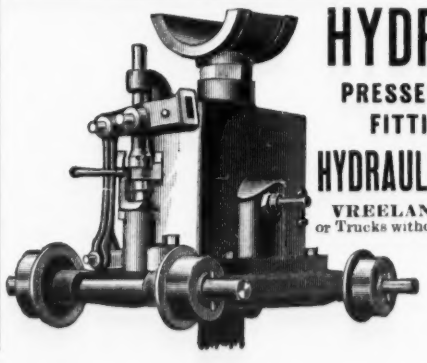

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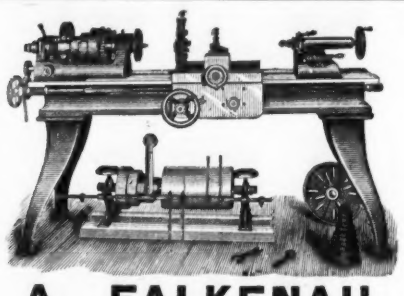

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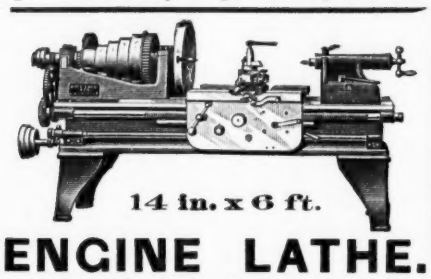

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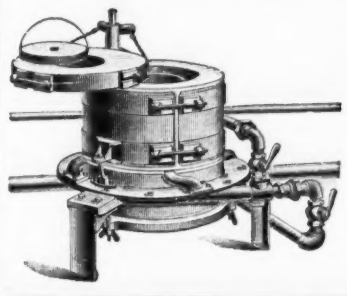

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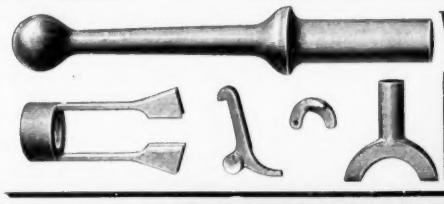

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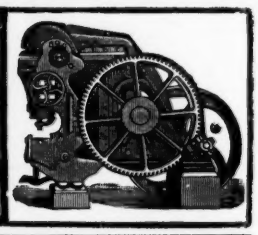

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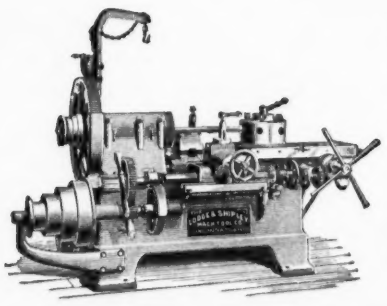

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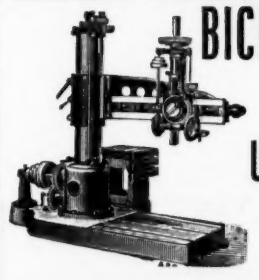

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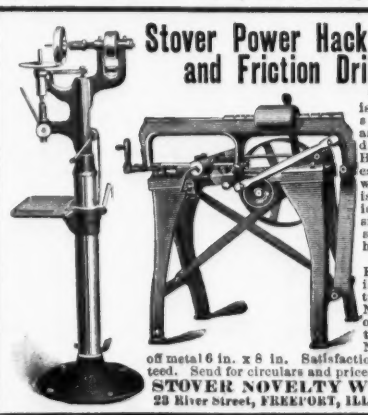

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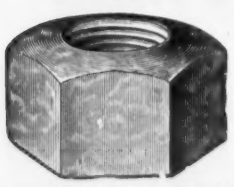

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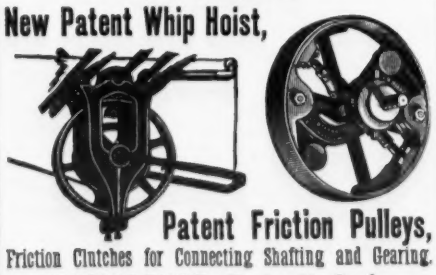

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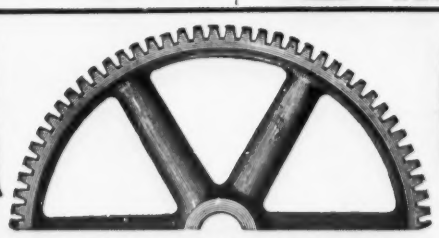

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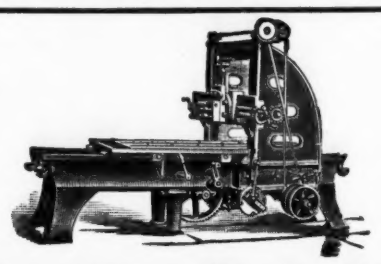

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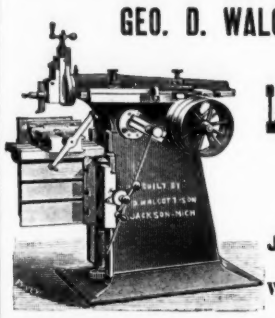

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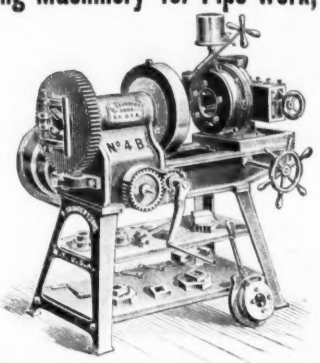

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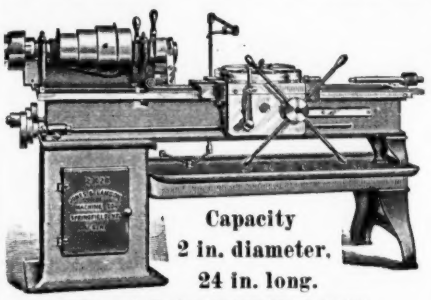

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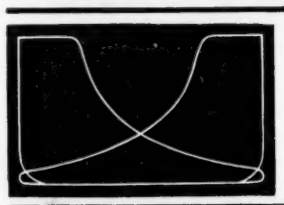

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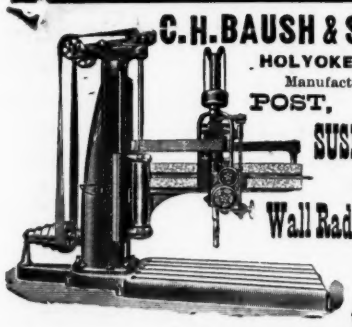

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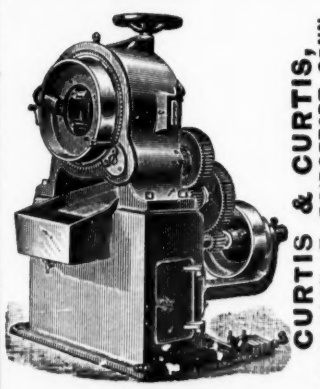

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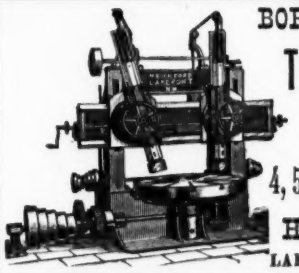

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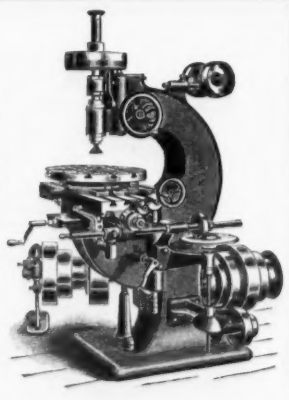

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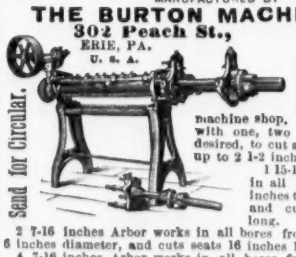

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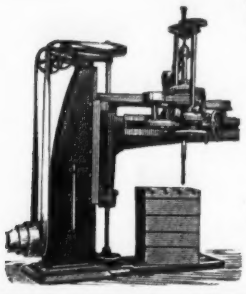

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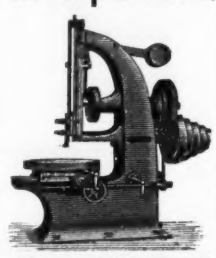

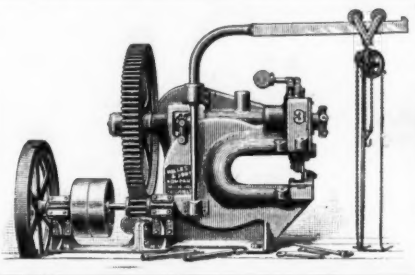

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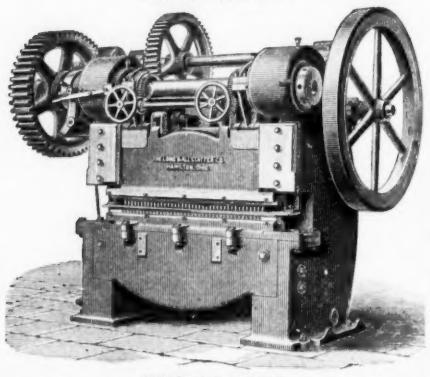

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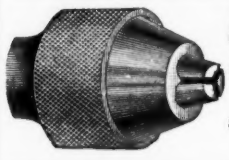

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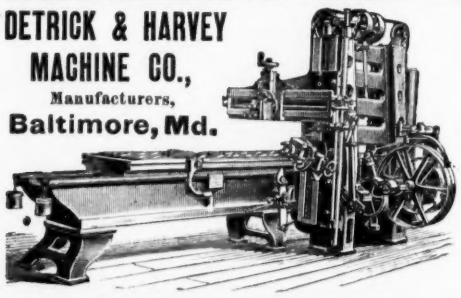

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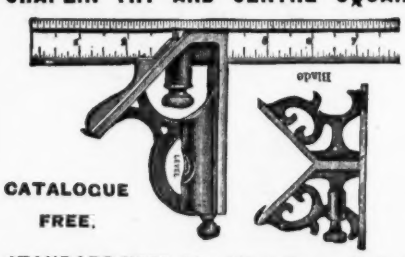

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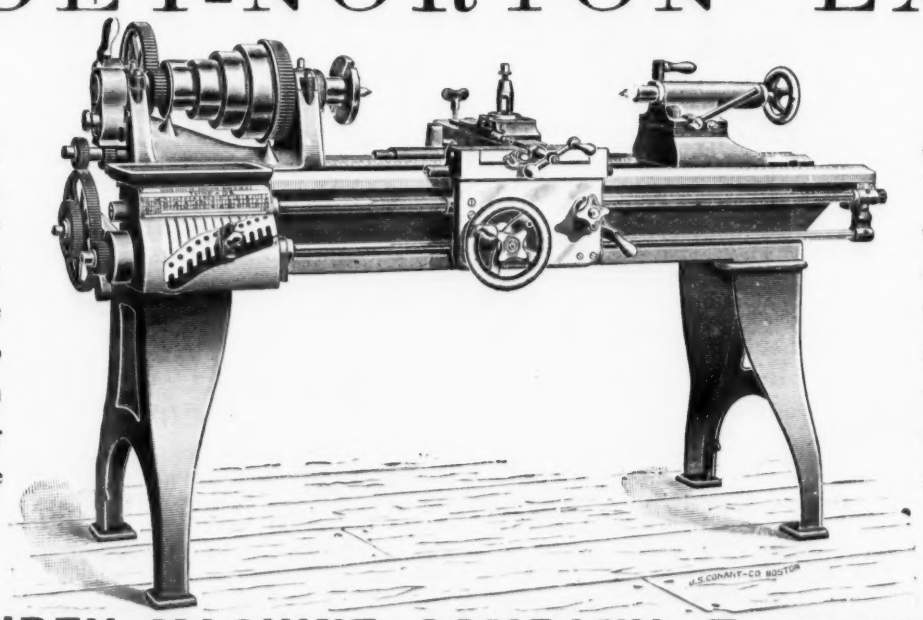

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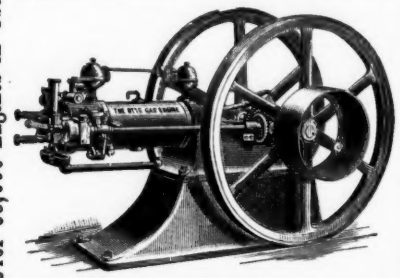

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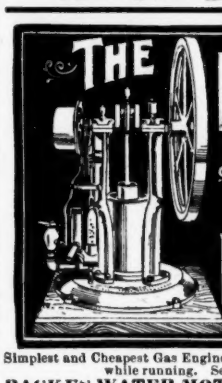

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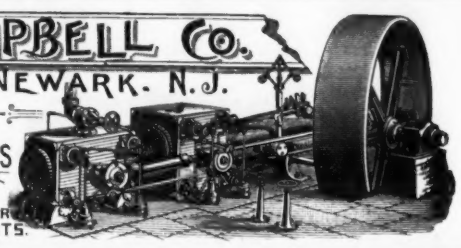

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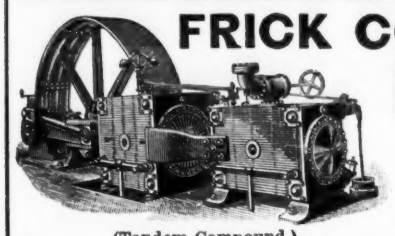

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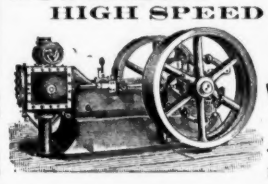

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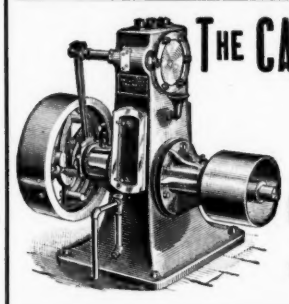

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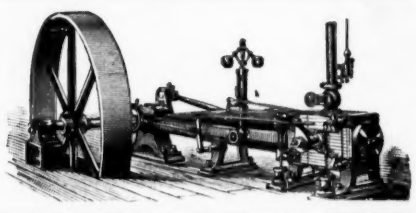

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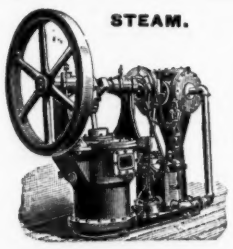

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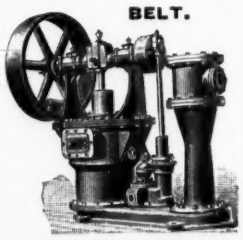

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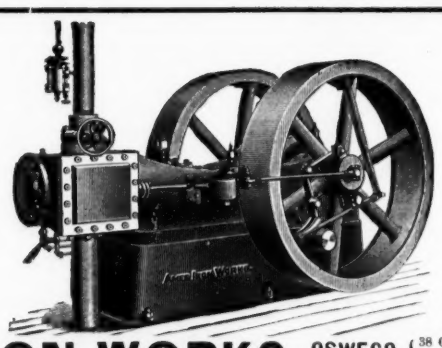

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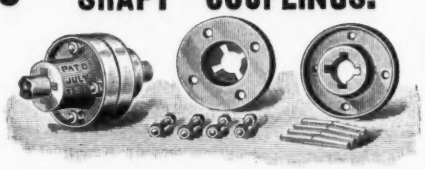

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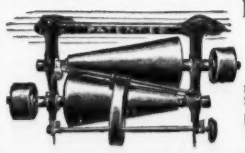

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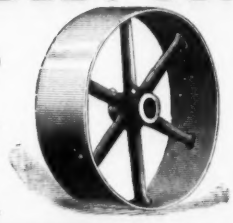

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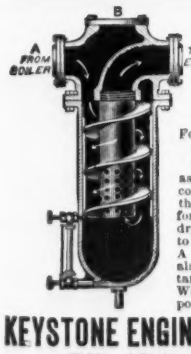

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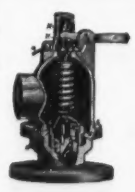

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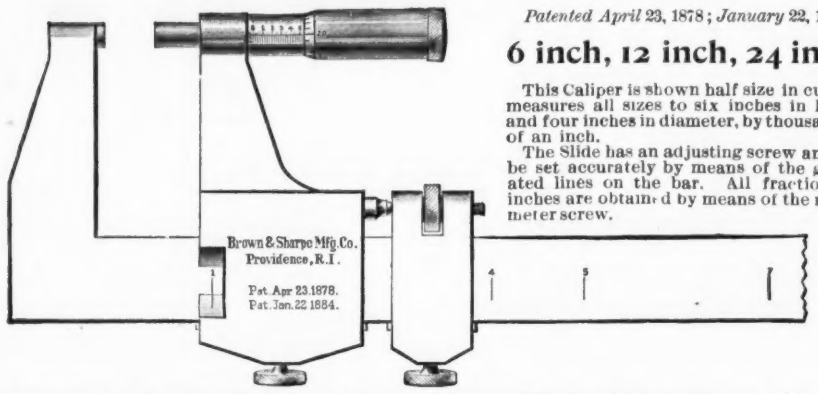

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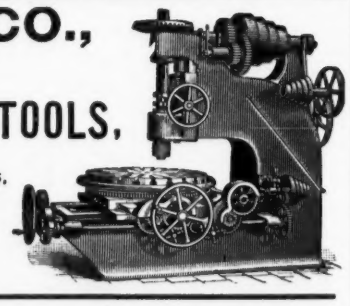

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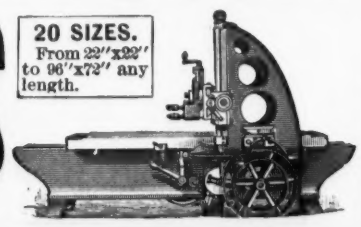

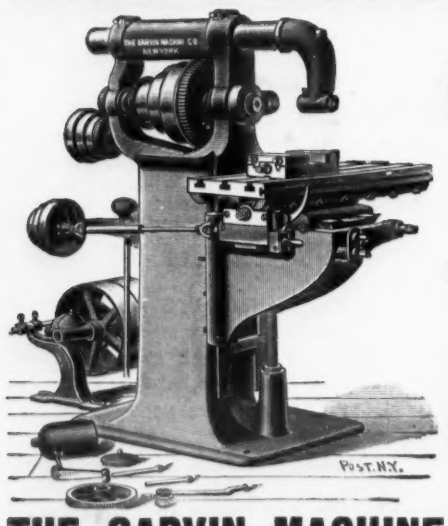

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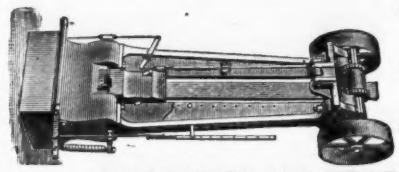

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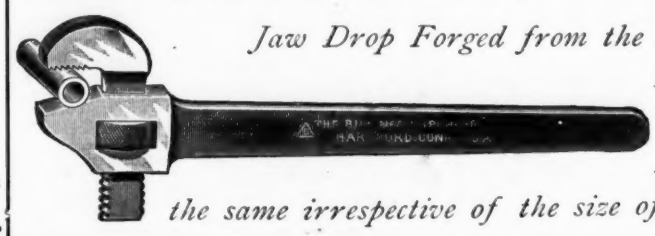

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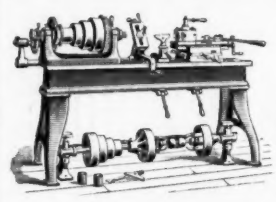

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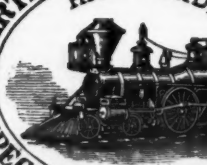

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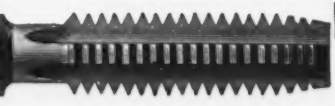

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